THE TELEGRAPHIC JOURNAL AND

Electrical Review.

VOL. XIX.—No. 451.

COMPOUND WOUND DYNAMOS.

THE first skirmish of the battle over the compound-winding principle in dynamo-electric machines took place in Vice-Chancellor Bacon's Court last Friday, when the Anglo-American Brush Corporation moved for an injunction restraining Messrs. Crompton and others from infringing the Brush patent of 1878. According to the only newspaper report of the case which we have seen (that in the *Daily Chronicle*) it was stated that "By the invention of Mr. Brush, an American gentleman, a sufficient electric current to render lighting by incandescent lamps practicable was for the first time enabled to be generated." Possibly this was an error on the part of the reporter, for the statement is distinctly false, and could scarcely have passed without challenge. Machines were in existence years before the date of the Brush patent which could well have been employed in conjunction with the incandescent lamps of to-day, had these been forthcoming. But the fact is that at the period of Brush's invention there was no incandescent system such as we now know, although fine carbon rods in a partial vacuum or in nitrogen gas had been employed. The case being *sub judice*, we withhold any opinions we may entertain respecting its merits, and content ourselves with pointing out the similarity between Varley's patent of 1876 and Brush's patent of 1878 as detailed in the REVIEW for September 26th, 1885.

The Vice-Chancellor on Friday, with the consent of the parties, ordered the motion to stand over until the trial of the action, upon each party undertaking to keep an account of the sales of machines made upon the "compound-wound" and the "constant potential" principle respectively.

INCANDESCENT LAMP PATENTS.

THE Brush Corporation has done wisely in offering to give a formal guarantee to all users of the "Victoria" incandescent lamp against any such claims as those recently formulated by the Edison-Swan Company. Its action will tend to inspire much-needed confidence among its customers, and the pity is that other makers of incandescent lamps cannot follow its excellent example. Our views on the threatened onslaught of the Edison Company were pretty fully expressed in our last issue, and we need refer to them again only to state that they have met with the emphatic approval of a large number of our readers. The Edison Company doubtless considers, on the strength of Mr. Justice Butt's decision, that not merely the lamps of Woodhouse and Rawson, but nearly all forms of incandescent lamp now before the public are infringements of its rights. This assumption will certainly be contested, and in the face of the prompt action of the Anglo-American Brush Company we do not think we shall be far wrong in predicting another legal suit upon this question. Should our surmise prove correct, however, we trust that the defending party will strive to secure stronger support both legally and scientifically than that with which the defendants in the recent action came into court, when, as a New York contemporary remarks: "In the matter of expert testimony especially the complainants seem to have had the advantage."

CRITICAL SPEED.

WE note in the pages of our esteemed contemporary the *Electrician* an article from the pen of Prof. S. P. Thompson, in which he seeks to justify his objection to the term "critical speed" as meaning the speed at which a dynamo will just excite itself. Prof. Thompson holds that "critical speed" ought to be restricted in its meaning to the speed at which a compound dynamo will regulate, and proposes to call the revolutions required just to produce excitement in a machine, "dead turns." We fail to see where the advantage lies. As we pointed out in our leader of May 14th, 1886, the meaning of "critical speed" is well understood by electricians, and only the Professor himself has given to the term a signification which had not been assigned to it previously. Critical speed has always been considered in relation to the resistance in circuit, and not as something which simply depends on the construction of the machine, as Prof. Thompson would in his article lead readers to suppose. To us the term "critical speed," when used in the sense hitherto employed, seems most apt, as it expresses an unstable, *i.e.*, critical condition of the machine, in which the slightest variation of either speed or resistance will cause the current to greatly increase or disappear altogether. On the other hand, "critical speed" is a term singularly inapplicable to the speed at which compound machines will regulate, as there is nothing critical about this speed; it is independent of the external resistance, and a small difference in the number of revolutions will only increase or diminish to a small extent the E.M.F., the power of the machine to regulate being unaffected. For the speed at which a compound machine regulates, the simple definition of "regulating speed" has been and is constantly used, and it is not likely that practical men will substitute for this a less apt and more unscientific definition because of Prof. Thompson's likes and dislikes.

West African Cables.—The African Direct Telegraph Company announces the opening of its station at Sierra Leone, on the West Coast of Africa, with a direct service *vid* St. Vincent.

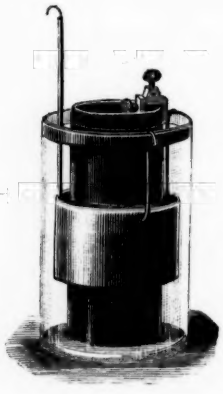
THE DUN BATTERY.

THE inventor of this new battery, patented by the firm of Schaefer and Montanus, of Frankfurt, has endeavoured to apply as a depolarising agent the well-known properties of permanganate of potash. The positive pole of this element is formed by a hollow cylinder of coke, fitted with a bottom and partly filled with small coke. The negative pole is formed of a cylinder of zinc surrounding the former and separated from it by two rings of caoutchouc; the whole is contained in a glass vessel.

The permanganate of potash is introduced into the cylinder of coke, and the entire element is filled with a lye of caustic potash in the proportion of one part of potash to five of water. The permanganate dissolves in the potash and acts as an oxidiser and depolariser on the surface of the coke.

In the state of rest this battery is not impaired and the zinc consumed will be always proportional to the quantity of electricity produced; lastly there is no escape of gas.

The constants of a Dun element of the size of an average Bunsen are:—electromotive force, 1·8 volt; current on short circuit, 15 to 20 ampères; internal



resistance (calculated), 0·09 to 0·12 ohm. After 30 to 40 minutes on short circuit the electromotive force falls to 1 volt, and the current to 8 or 10 ampères, an intensity which it then retains for a long time. The element is regenerated after one or two hours' rest and recovers the electromotive force indicated. In the case of the production of feeble currents the depolarisation is complete and the element is constant.

The exhausted liquid, which contains the zinc consumed, may then serve for coating metals with zinc, especially iron, without the need of an auxiliary battery. An electrode of zinc and the object to be coated are sufficient.

This battery should be recommended to galvanisers who at present employ chiefly the Bunsen battery, the use of which, independent of its inconveniences, is much more costly.

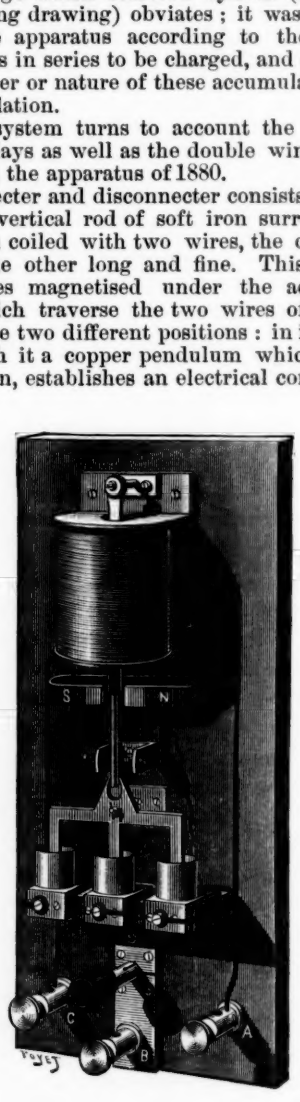
AUTOMATIC MAKE AND BREAK FOR CHARGING ACCUMULATORS.

THE charging of accumulators from irregular sources of electrical energy entails special precautions in order to prevent the accumulators from discharging themselves into the generator and so stopping its working. The object of the connecter and disconnecter is to bring the accumulators automatically into communication with the source from which they are charged, when the latter has sufficient electromotive force to effect this operation and to break the communication as soon as the electromotive force of this source becomes insufficient.

We have already, writes "E. H." in *La Nature*, called attention to an apparatus constructed for this purpose, but it involved, from a practical point of view, a disadvantage which this new system (shown in the accompanying drawing) obviates; it was necessary to regulate the apparatus according to the number of accumulators in series to be charged, and every change in the number or nature of these accumulators requires a fresh regulation.

The new system turns to account the properties of polarised relays as well as the double winding already employed in the apparatus of 1880.

The connecter and disconnecter consists of a magnet, N, S, and a vertical rod of soft iron surrounded by a fixed bobbin coiled with two wires, the one thick and short and the other long and fine. This rod of soft iron becomes magnetised under the action of the currents which traverse the two wires of the bobbin and may take two different positions: in its movement it draws with it a copper pendulum which, according to its position, establishes an electrical communication



between the iron trough in the middle filled with mercury and one of the two troughs at the side also filled with mercury. The fine wire of the coil is in circuit with the accumulators to be charged, and with the source of electricity, say a dynamo, for example. If the latter is stopped, the current traversing the coil of fine wire enables the pendulum to establish contact between the middle trough and the one on the left; in certain special cases this trough closes the circuit on an electric bell placed between the point, C, and the accumulators, which thus gives notice that the machine is not charging.

When the machine is at work and producing an electromotive force greater than that of the accumulators, the polarised relay is attracted in the opposite direction, and the pendulum makes contact between the centre trough and the right hand one. At this moment the thick wire becomes established in derivation on the extremities of the fine wire, and as it has a very small resistance it enables the machine to charge, at the same time keeping the rod of the relay in the right position for the charge.

When the speed of the machine slackens, so that the charging current ceases to act and begins to change its sign, the pendulum breaks the thick wire circuit and the apparatus returns to its first condition. We see thus that the system works without any regulating, influenced

simply by the superiority or inferiority of the opposing electromotive forces of the machine and the accumulators. The sensibility is modified by acting on two screws which regulate the play of the armature. The apparatus is very easily placed in circuit by connecting the terminal, A, to the positive pole of the accumulators, the terminal, B, to the positive pole of the dynamo, and the terminal, C, to the bell that gives notice if required. All the details have been carefully studied by M. Simmen, the constructor of the apparatus, in order to render the working of it perfectly sure, and with this object the contacts are all of mercury, the only ones that can be relied upon for industrial currents. The fine wire has sufficient resistance, from 300 to 2,000 ohms, according to the average number of accumulators to be charged to ensure only a very small fraction of the charge being expended while the dynamo is not charging. When the machine is voluntarily stopped for a lengthened period, it is only necessary to withdraw the key placed above, B, in order to break the communication between the dynamo and the accumulators, and so to suppress this slight loss.

ELECTRICITY AND SHAFTING.—A SIMILE.

FOR purposes of illustration the electric current is frequently likened unto the flow of a fluid. But the hydraulic simile has the disadvantage of suggesting the actual transport of something ponderable, while there is every reason to believe that nothing but energy is transported.

A simile which is free from this objection may be drawn between the flow of electricity and the motion of a system of shafting. Thus the fact that the current strength is the same in all parts of the circuit may be illustrated by the rotation of the shafting which is the same throughout, while the linear velocity (say of the centre of gyration) illustrates the strength of the current, and the angular velocity the density of the current. In an electric circuit heat is generated throughout by the resistance of the conductor; in a similar manner the friction of the shafting at its points of support generates heat throughout its length.

The torsional strain of the shafting well illustrates an electric potential; while at points of the shafting where work is performed the difference of the torsional strain illustrates the corresponding difference of potential at points where work is performed in an electric circuit. In like manner the electric inertia of the circuit may be illustrated by the inertia of the system of shafting.

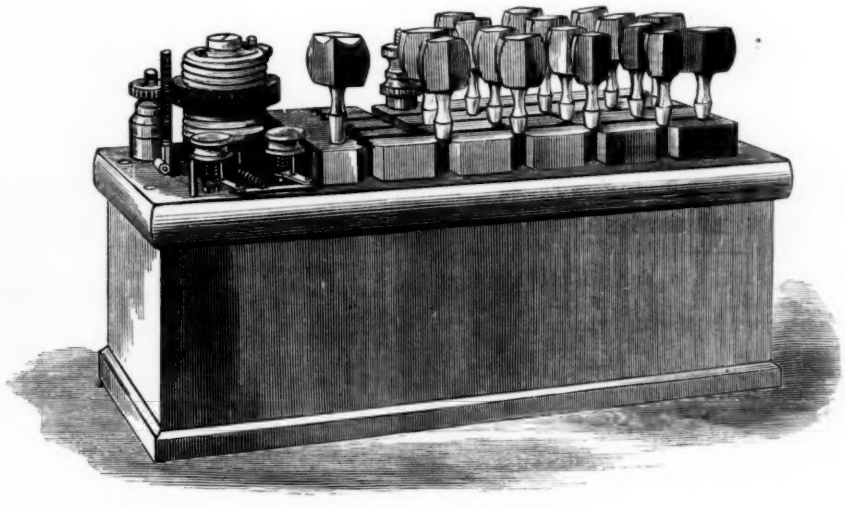
W. MOON.

PORTABLE TESTING BRIDGE.

THIS bridge, which is shown by the fig., is the design of Messrs. H. Davies and E. J. Moynihan, of the Woodhouse and Rawson Electric Manufacturing Company, and has been brought out by the latter firm; it is one of the neatest of the kind yet devised. It is chiefly noticeable for the extreme compactness of its form and the wideness of the range of resistances which it enables to be measured. The apparatus actually consists of two parts, viz., an ordinary and a metre (or slide wire) bridge; by means of simple, but ingenious switches, the battery, galvanometer and line terminals are common to both bridges.

The first bridge, which is separated from the second by the infinity plug hole, is a Wheatstone plug bridge, capable of measuring resistances from 1 ohm to 10 megohms.

This has coils of 100 ohms and 10 ohms in one ratio arm and 10 ohms and 10,000 ohms in the other, together with coils giving a total resistance of 10,000 ohms in the adjustable arm. The second bridge, by which resistances may be measured from ·001 to 100 ohms without using a greater ratio than 10 to 1 in either direction, is a very ingenious modification of a slide wire bridge in which the slide wire is coiled in one groove, and the battery lead in the other groove of a double threaded screw cut on an ivory cylinder. Contact is made between the two wires by a double brass



spring attached to an ebonite ring which screws up and down on the ivory cylinder, the ring being graduated from 0 to 100 on each half of its circumference, the number of half turns being shown by a vertical graduated scale. The whole length of the slide wire is thus divided into 1,000 parts. The resistance is measured by adjusting the point of contact on the slide wire which forms the ratio arms of the bridge balanced against the most suitable of four coils which respectively have resistances of ·01 ·1 1 and 10 ohms. The infinity plug hole and the plug holes of these four coils are larger than those of the other part of the bridge, and have but one plug between them, the two bridges being separated by the infinity plug hole. When the bridge is used for high resistances the contact keys are turned to "high" and the infinity plug is put in; when it is used for low resistances the contact keys are turned to "low," and one of the four above-mentioned coils plugged, leaving the infinity hole unplugged. The use of the slide wire is particularly advantageous, indeed necessary, for the measurement of low resistances, and combined with the other bridge gives everything required for contractors testing, and work of a similar character. The bridge is usually fitted into a strong

box convenient for carrying it. This also contains a pair of large Woodhouse and Rawson's split terminals for connection to heavy cable, and a very delicate astatic galvanometer (for which a compartment is provided at one end of the case) with suspended needles, which is particularly neat and compact, and is provided with levelling screws.

That this is really a *portable* apparatus, while being perfectly accurate, is evident from the fact that the outside dimensions of the case carrying the bridge, spare terminals, battery, galvanometer and leads are only 13½ inches × 5½ inches × 7½ inches; the dimensions of the bridge are 9½ inches × 4 inches, and it is undoubtedly the smallest made with so large a range.

The workmanship and accuracy are of a high standard, and the bridge will fully meet the purposes for which it is designed.

The battery in the earlier form was contained in the case, but in the newer pattern the designers have (and most wisely, we think) discarded this arrangement, and provide the battery in a separate case.

Although the galvanometer designed for use with the bridge is remarkable for its sensitiveness, and with great care will enable resistances of very wide limits to be measured with a considerable degree of accuracy, yet we think the common practice which has been followed, of trying to make one instrument serve the purpose, is a mistake. In our opinion two galvanometers at least ought to be furnished, one for high and one for low resistances; indeed, we would go so far as to advocate the provision of as many as four galvanometers, for "very high," "high," "low," and "very low" resistances, respectively. The idea of supplying "coils" for the galvanometer of different resistances, which can be changed, is an objectionable arrangement; we should much prefer four distinct instruments complete in themselves.

AN IMPROVED THOMSON'S "LITTLE" SIPHON RECORDER.

THE improvements in this recorder, which have been effected by Mr. England, of the Mexican Telegraph Company, Galveston Station, are shown in the figure, and are as follows:—

Improvement 1.—Incandescent lamp. Battery is connected to the connecting screw plug, A, the other pole to screw, B, above it.

When light is desired, screw plug, A, is placed in the hole, C, made in the bottom of support which holds the lamp, this support is one conductor, and the wire wound around it is the other.

Battery used is the "Volta pavia."

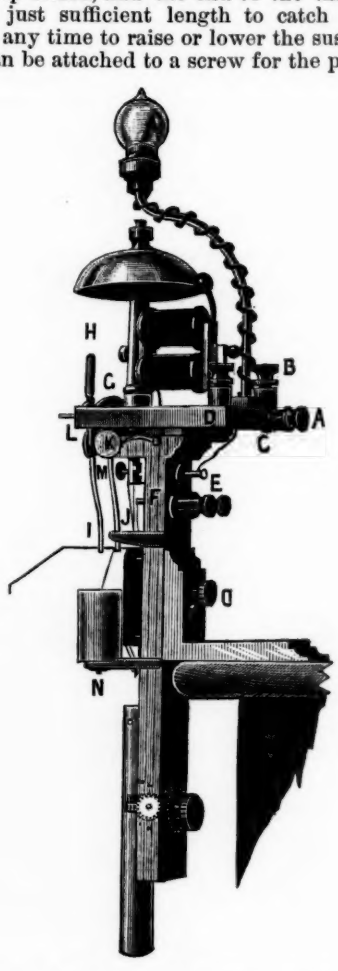
Improvement 2.—The bell. Battery is connected to the two terminals, B and D, one of these terminals, B, is connected by wire underneath ebonite slab to a screw, E, which pierces the centre piece, F, and carries connection to the piece of platinum on which the siphon is placed, the other pole is connected through the bell to the top of the forked platinum switch, G, so that when the handle, H, of the switch is turned over it brings the forks, I, J, into position, and places them very close to the piece of platinum supporting siphon; therefore with the least movement of the coil to either side the platinum will touch one of the forks alternately, and the circuit being thus completed, the bell rings. The forks are adjustable to any position of coil. The device in no way lessens the free movement of coil; first class signals at a speed of 30 words per minute, averaging five letters to a word, can be obtained.

Improvement 3.—The coil adjuster. By a simple turn of either of the two screws, K, L, on the side and front of centre piece any adjustment can easily be obtained, without altering or interfering in any way with the top suspension; also such adjustment can even be made while receiving signals, affecting them but very slightly.

With the old device, if a different adjustment of coil was needed, the top suspension screw had to be loosened, which allowed the coil to drop more or less, and it was frequently difficult to obtain the desired adjustment, one working blindly as it were.

This top suspending screw and adjuster has been done away with in the new device.

Improvement 4.—"Coil suspender." The thread is placed in a grip, M, opened and closed by a screw, the thread is run through a small hole in one of the pieces forming the grip, coil is raised to any height desired, and the grip closed, and the end of the thread can be left free, just sufficient length to catch hold of if desired at any time to raise or lower the suspension, or the end can be attached to a screw for the purpose.



Improvement 5.—"The cover cap." (Not shown in the figure, being taken off in order to show the upper part of the coil and connections.)

This completely protects the upper portion of coil and connections from dust, rust, and injury, its attachment is such that it can be rapidly taken off and replaced, no screws being employed.

Improvement 6.—The adjustable ink well.

A device, N, which can be raised or lowered with the aid of screw, O, so that if the ink should run low and below the end of the siphon in the well, the well can be raised, this can be repeated till there is hardly any ink left in the well—the well can also be easily and quickly detached, the bottom having a catch which fits in a slot.

We are indebted to Mr. England for a photograph and description of his improved apparatus.

Electric Lighting at Kettering.—Messrs. E. L. Berry and Co. recently lighted the Corn Exchange at Kettering with five arc lamps of the Tallenta type, Goolden and Trotter's patent, and on the occasion of a fête in the Rectory grounds at the same place they put up an installation of five arc and 80 coloured incandescen lamps with success.

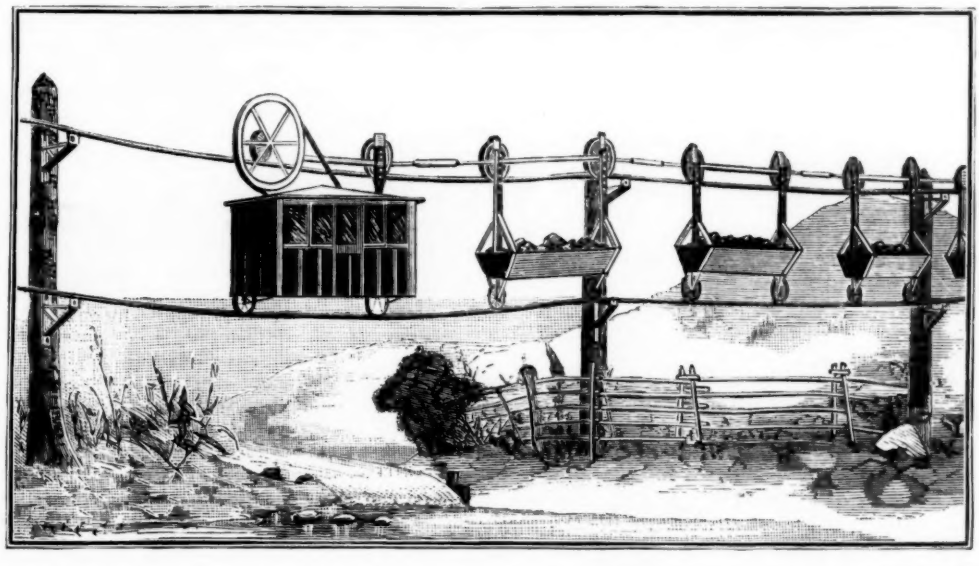
AN ELECTRIC WIRE ROAD.

A SYSTEM of transporting freight and passengers is being introduced, the *Electrical World* states, by the Suspension Transportation Company, of 40, Water Street, Boston, under various patents, covering the use of electricity, steam or other motive power for aerial transportation.

The general *modus operandi* of this company's system for an electric wire road, which resembles strongly the late Prof. Fleming Jenkin's system of telpherage, is illustrated in the engraving. It is claimed that such a system, while not interfering with the cultivation of the soil or with pasturage, is free from danger to man and beast, and a mere right of way is sufficient without the cost of the fee; that it requires no cuttings or fillings, and is thus adapted to uneven, rocky, or uncleared land, the turning of sharp curves presenting no obstacles. In crossing streams no bridges need be used.

An experimental line of this character, with a capacity for transporting several tons in weight upon the cables, is said to be in successful operation at the works of Mr. Leo Daft.

The posts that carry the cables are placed 30 feet apart, and the cables are supported upon wrought iron brackets bolted to them. The cables rest upon rubber strips placed in clamps at the end of the braces, and are of steel, the upper being 2 inches in diameter and the lower 1 inch. These are placed in the same vertical plane and are 7 feet 6 inches apart. The current



passes from the upper to the lower cable, the motors being in parallel or multiple arc between them. The motor within the car is geared to a large wheel mounted upon the same shaft with the forward grooved traction wheel, and is pivoted on one end, so that all slack in the belt may be readily taken up. The braking will be accomplished by electrical means, but hand brakes are also provided, and can be applied through the medium of the long lever entering the car, the other end of the lever being attached to the rod connecting the brake shoes on the two wheels. Two safety catches are attached to each car and are placed alongside the upper wheels. They prevent the car from leaving the cable in case of a running off of the wheel.

In all cases where the grade is much above ground it is proposed to stretch a safety wire from bracket to bracket, thus ensuring against accident.

The system, it is claimed, is adapted not only for the transportation of goods, but for passenger traffic. The rate of speed will depend on the service to be rendered; as high as 25 miles an hour, and even more, is spoken of. At the recent Novelties Exhibition in Philadelphia the system was practically operated upon a small scale, and attracted considerable attention.

TO ADJUST TANGENT GALVANOMETERS.

THE following method of adjusting a tangent galvanometer is probably well known, but I do not know that it has been previously published.

Take two deflections, with the same current, one on each side of the scale. Let d be greater than d_1. Then

$$\frac{\text{(sin. } (d - \delta)}{\text{cos. } d} = \frac{\text{sin. } (d_1 + \delta)}{\text{cos. } d_1}$$

where δ is the angle the coils form with the magnet.

$$\therefore \quad \frac{\text{sin. } d \text{ cos. } \delta - \text{sin. } \delta \text{ cos. } d}{\text{cos. } d}$$

$$= \frac{\text{sin. } d_1 \text{ cos. } \delta + \text{sin. } \delta \text{ cos. } d_1}{\text{cos. } d_1}$$

$$\therefore \quad \text{tan. } \delta = \frac{\text{tan. } d - \text{tan. } d_1}{2}$$

Now let the instrument be turned through the angle $\delta = \text{tan.}^{-1}\left(\frac{\text{tan. } d - \text{tan. } d_1}{2}\right)$ in the direction of the smaller deflection. Then adjust the pointer until it points to zero again. If the scale of the instrument is movable the adjustment may be made by turning the scale through the angle, δ, in the direction of the greater deflection instead of bending the pointer.

W. MOON.

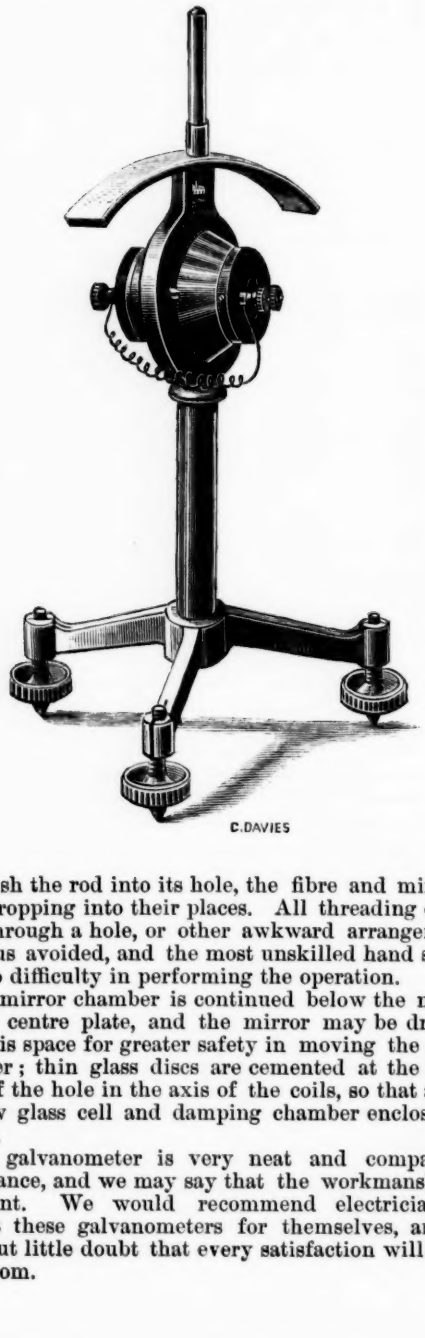
NEW MIRROR GALVANOMETER.

WE illustrate a new galvanometer lately brought out by the Woodhouse and Rawson Electric Manufacturing Company, which supplies the felt want of a good and moderate priced instrument. It will be seen that its construction is quite plain and strong, but a description of it will show that all the necessary conditions of a really good instrument have been carefully considered, and that it has many advantages over some of the more complicated forms now in use.

The centre plate is mounted on the pillar and tripod and carries the controlling magnet and fibre suspension. This plate is recessed on either side, so as to leave less than $\frac{1}{16}$-inch of metal at the middle, and into these recesses are fitted the coil cases, which are somewhat of a conical shape; each coil case is fastened to the centre plate by two screws through its flange, so that it can be easily removed in a few seconds. The wire completely fills the cases right up to the thin part of the centre plate, except for the usual hole in the axis of the coil, and its section is such that the maximum effect on the needle system is obtained for the given amount of wire; the coil is thoroughly

insulated and cemented into its case with paraffin, its ends being connected to two terminals on the ebonite disc, forming the outside end of the case. As each coil is perfectly independent, the instrument can be used as a differential galvanometer, or the coils can be joined up in series or parallel. The coil cases are all made to template and pairs with wire of any desired resistance are supplied which can, with the greatest ease, be mounted and detached, so rendering the instrument suitable for any kind of work.

One of the chief features of the galvanometer is the form of the needle suspension. The fibre is attached to a split rod with a milled head, which fits friction tight into the bottom of the magnet rod, the milled head being between the legs of the saddle supporting the magnet rod, as shown. A vertical slot is cut right through the thin part of the centre plate and half way through its thick rim underneath the suspension, so that by simply removing the front coil case the milled head may be drawn down and brought clear out in front with the fibre and mirror. The introduction of a new fibre and mirror is therefore extremely easy, it only being necessary to fix this to the suspension rod



and push the rod into its hole, the fibre and mirror at once dropping into their places. All threading of the fibre through a hole, or other awkward arrangements, are thus avoided, and the most unskilled hand should find no difficulty in performing the operation.

The mirror chamber is continued below the middle of the centre plate, and the mirror may be dropped into this space for greater safety in moving the galvanometer; thin glass discs are cemented at the inside ends of the hole in the axis of the coils, so that a very shallow glass cell and damping chamber encloses the needle.

The galvanometer is very neat and compact in appearance, and we may say that the workmanship is excellent. We would recommend electricians to inspect these galvanometers for themselves, and we have but little doubt that every satisfaction will result therefrom.

TELEPHONE COMPANY OF PARIS.

IN our last issue we referred to a scheme for the reorganisation of the French telephone service, brought forward by M. Gravet, the Minister of Posts and Telegraphs. We are now able to add a few particulars.

The present telephone system was established in 1878, and the organisation is of the most rudimentary nature, and utterly inadequate to keep pace with the ever-increasing demand for efficient telephone service. M. Gravet proposes that the exclusive right for carrying on telephone work shall be granted to a company which shall farm the telephones for 35 years. The company must buy up all telephone installations already existing. The work shall be carried on under Government inspection, and for this purpose a Comptroller-General shall be appointed. The company farming the French telephones shall be bound to place, free of charge, telephone instruments in all the communes of the Republic which are unprovided with telegraph offices. At present nearly all cantonal centres have a telegraph office which, as a rule, serves four or five communes, to which telegrams are carried by express messenger at an extra charge of 50 centimes per kilometre, a heavy additional expense to the cost of a message, and so slow a means is this of forwarding telegrams, that the post is generally made use of in preference. These drawbacks would be avoided by the new scheme.

It is proposed that all communes, on application, shall be directly joined by a telephone line to their cantonal centre or to the nearest telegraph office. The farming company will supply the transmitting instruments, and the communes will only be subject to the cost of the line, which will be constructed for them by the Government at the charge of 100 francs per kilometre.

With regard to the large towns, there will be a notable improvement in the means of communication through the new system. For instance, in Paris at present the only office at which a telegram can be sent during the night is the central office at the Bourse, a serious inconvenience to those living at a distance. M. Gravet's scheme will enable the public, at any hour of the night, to hand their messages in at the nearest telephone office, whence they will be sent to the central office to be forwarded thence in the ordinary way. *Vice versâ*, a telegram arriving at the central office will be sent to the telephone office of the quarter in which the destinaire lives, and an official of the company will immediately take it to the address.

The telephone subscription will also be reduced to 600 or 400 francs for Paris, and to 400 or 300 francs for the provinces. These figures will be further reduced so soon as the company makes a certain profit on the work.

The lines established for Government work shall have a reduction on these figures of 50 per cent., and a reduction of 25 per cent. shall be given to those for departmental service. If the farming company makes a profit of more than 6 per cent. on the capital employed, the Government shall share in the excess to an extent of 15 per cent.

The company binds itself to repay the Government all the expenses the latter has gone to in constructing the lines now worked by it, and to buy, for the future benefit of the Government, the systems worked by the Société Générale des Téléphones.

The company binds itself to redeem its share capital of 25 millions (francs) during the duration of its concession. At the expiration of the 35 years the Government shall come into possession of the whole of the company's systems without having to make any payment whatever.

When the capital has been completely utilised the Government can oblige the company to obtain fresh resources for the extension of the telephone system. This will be done by means of bonds; the value, duration, and manner of redemption, being determined by the Government.

The Government has the right of intervention in the

appointment of the company's officials, and in the control of the company's accounts. For the latter purpose a committee will be appointed by the Government, the company being obliged to pay all expenses connected with this control.

The construction of the telephone lines will be carried out by employeés and with material selected by the Government, at the expense of the company.

In case of war, or in any exceptional condition of affairs, the Government can suspend the telephone service without incurring any liability towards the company or the subscribers.

At the end of the first ten years of working, the Government has the right of buying back the concession at a price to be fixed upon by a committee of experts.

INCANDESCENT LAMP PATENTS.

EDISON *v.* WOODHOUSE AND RAWSON
AND
EDISON AND SWAN UNITED ELECTRIC LIGHT COMPANY *v.* WOODHOUSE AND RAWSON.

(*Before* MR. JUSTICE BUTT, *sitting for* MR. JUSTICE NORTH.)

(*Continued from page* 40.)

Friday, May 14*th*, 1886—(*continued*).

THE SOLICITOR-GENERAL: It was a most remarkable improvement. My clients, the gas company, were held to be entitled to it. It was their idea, not Mr. Patterson's; but that was not the point. They were all agreed you could not have a patent for that; you could not have a patent for the use in a particular manner of a well-known machine by changing the quantity of your lime, although that made all the difference, and by changing the order of your purifiers, and by changing the time at which your purifiers were to be cleared out; you could not have a patent for that. Lord Justice James said, what seems to be extremely pertinent to the present case, "Where are you to draw the line? How am I to ascertain it? You tell us you are to change your purifiers more frequently"—just as this gentleman tells us we are to have a conductor with a smaller sectional area. I ask, what smaller sectional area? A patentee who comes and claims a monopoly is bound to give us something definite, bound to tell the public what they may do and what they may not do, and Lord Justice James put that very case. He said, suppose a man tells you that you are to clear out your purifiers more frequently, that you are to use more lime or less lime, where am I to say that a man infringes that patent? How is the Court to say what comes within the patent and what does not? I apply the observations which I am now going to read to you exactly to this case. They tell us that it is entirely a matter of degree, and that it is impossible to draw the line and to say what will be a filament and what will be a pencil. Kay *v.* Marshall, which I referred to, is reported in 8 Clark and Finelly's Reports, page, 245: "A patent had been obtained for new and improved machinery for preparing and spinning flax, hemp, and other fibrous substances by power. The improvement as to the spinning consisted in the placing and retaining the drawing rollers nearer to each other (at the distance of two and a half inches) than they had ever been used before in flax spinning; the shortening of the reach being rendered practicable by the maceration of the flax in the new machinery for preparing it. But spinning machines varying in the distance of the reach according to the length of the fibre of the substance to be spun, had been in use before the patent was obtained. Held that the machinery for spinning was not a new invention, and that the patent was not valid in point of law." That, I think, sufficiently describes what the patent was for. Now what Lord Cottenham says is this: "Now all the variations which the plaintiff introduced into the ordinary spinning machine which he claimed as his invention is fixing the rollers at two and a half inches distance from each other; and that, he states, is such an improvement to the ordinary spinning machine as entitles him to be protected from all the rest of the world against their using spinning machines with the rollers at that distance. It is not, as was argued at the bar, one invention, namely, the macerating of flax, and using the flax so macerated with a particular machine." I say here the second claim is not one, we cannot too often bear in mind, for a particular mode of making a carbon filament. "The earlier part of the invention he not only does not claim as against the defendants, but does not complain of the defendants as having used that which, in point of fact, it is quite clear they did not use; and, in point of fact, it is quite clear that he has not adopted that mode. Another mode has been adopted by macerating the flax, and the flax so macerated by another process has been used in a machine with rollers at the distance of two and a half inches. If the patent be good as far as the spinning machine is concerned, that is to say, if the plaintiff has a right to tell the defendants and all the rest of the world that they shall not use the common spinning machine with rollers at two and a half inches distance, then the existence of the patent deprives the defendants and all the rest of the world of the right of using the ordinary spinning machine in the form in which they had a right to use it before the patent was granted. That is not the object of the patent, if he has discovered any means of using the spinning machine which the world had not known before, the benefit of that he has a right to secure for himself by means of a patent; but if this mode of using the spinning machine was known before—and the endorsement upon the postea states that it was known—then the plaintiff cannot deprive them of having the benefit of that which they enjoyed before. The endorsement upon the postea stating that the rollers had been used at a variety of distances, not precisely specifying two and a half inches, but stating that the differences had been made to vary according to the length of the fibre to be spun appears to me to establish a fact which is of itself conclusive against the plaintiff." Now, my lord, apply that in this case. Incandescent lamps known with carbon conductors generally, not specified as to size, all kinds of sizes used varying from Swan's pencil to what Roberts described as a band or strip of an inch wide—and, by the way, Roberts's carbon was a flexible one. Comes the plaintiff and tells Mr. Swan, if you reduce the size of your carbon conductor you will gain a particular advantage; and it was known—that is clear to demonstration, and in fact is not denied by any of the witnesses—that the resistance would vary according to the size of the carbon which you used. Well, my lord, is not that precisely similar to a man coming and saying, you shall not use your spinning machinery with rollers two and a half inches apart, and I claim a monopoly of that use of your rollers. Comes Mr. Edison and says, "You shall not use your incandescent carbon lamp with, I cannot say any particular measurement, but with a carbon conductor with a smaller sectional area which I choose to call a filament." I will refer your lordship now to Ralston *v.* Smith, reported in the House of Lords' Reports, page 223. It is one of the leading cases on the effect of a disclaimer, but I shall not trouble your lordship with that part of it. The marginal note, which I think sufficiently states the nature of the patent, is this: "Ralston took out a patent for 'improvements' in embossing and finishing woven fabrics and in the machinery and apparatus employed therein; in his specification he said: 'I employ a roller of metal, wood, or other suitable material, and groove, flute, engrave, mill, or otherwise indent upon it any desired design.' He caused this roller to revolve with a bowl at equal velocities, moving the fabric transversely when fed into the machine, and by these means he proposed to calender or finish and to emboss the fabric by one process instead of two as then practised. He afterwards entered a disclaimer, in which he disclaimed the words in the title, 'and in the machinery or apparatus employed therein,' and disclaimed the word 'wood' from the description of the roller and restricted the grooves or flutes on the roller to those of a circular kind. Any other grooves would not only not produce the desired effect of the fabric, but would destroy it. Held that the original specification read with the disclaimer did not describe anything which could properly be the subject of a patent such as he had taken out." The rest is on another point. Now, Lord Cranworth said this (page 250): "My lords, by far the most material question in this case is as to the issue which is raised in the sixth plea. Now, as to that, I confess I entertain no doubt whatever of the correctness of the Lord Chancellor's opinion, namely, that the amended specification," and so forth. "However, the use of the roller and the bowl for calendering, and of the roller and bowl for impressing the patterns was perfectly well known; and the use of the roller and the bowl going at equal velocities and at unequal velocities was also perfectly well known; and manufacturers were right in supposing that ordinarily speaking you could not cause the roller and the bowl to revolve at unequal velocities so as to impress the pattern, because it would cause destruction to the fabric. But what this gentleman discovered, and I think it was a very useful discovery, was that there was one particular sort of pattern which might be impressed upon the roller and made to revolve, the fabric being passed between the roller and the bowl at an unequal velocity without tearing. But I quite agree with what was said by Mr. Grove, and it could not possibly be disputed by any gentleman at the bar, that it is not every useful discovery that can be made the subject of a patent, but you must show that the discovery can be brought within a fair extension of the words, 'a new manufacture.' Now, how is this possibly to be called a new manufacture? I, as a manufacturer, have my roller, which I am in the habit of rolling upon a bowl (if that is the proper expression), the fabric passing between the two at equal velocities. Then I can impress my pattern upon it. I have my roller without any pattern engraved upon it; I can impress that at an unequal velocity, and it will calender. But I do not do them both at the same time, because I suppose that in so doing I should tear my fabric; and I rightly so suppose, until the plaintiff makes the discovery that there is one particular sort of pattern which may be produced without tearing the fabric. Now, that is a very useful discovery; but it would be strange to say that that is a new manufacture, and that therefore I am to be deprived of the most useful way of employing my roller. There is nothing new in the invention, except that I now know what I did not know before, that by a particular use of it I should obtain a result which I did not before know I could obtain." Then he refers to what had been said by Chief Justice Erle in the Court below. This is what the learned Lord Chief

Justice had said: "We also observe that a patent for the exclusive right to one particular use of a known machine might be objected to, although the patentee may have discovered how to use the machine more beneficially than the owner knew." Patterson *v.* The Gas Light and Coke Company is reported in the Court of Appeal, 2 Chancery Division, page 812: "Before the patent was taken out, the defendant company had been in the habit of using lime purifiers, by which sulphide of calcium had been produced, but they had not succeeded in attaining the desired purity on account of their failing to extract from the gas the whole of the carbonic acid contained in it, which impeded the operation of the sulphide of calcium in the purifiers. The plaintiff's invention mainly consisted in keeping a fresher supply of lime in the first series of purifiers, so as completely to eliminate the carbonic acid from the gas before it was passed on to the subsequent purifiers, in which the sulphide of calcium was produced." In other words, he described the process by which you were to use an additional purifier, by which you were to use a larger quantity of lime, and by which the lime was to be emptied at a particular point when the carbonic acid had converted the lime into the carbonate of lime. He was also to change the order in which it had been used. The statement is: "The crude gas was first passed through vessels called washers and scrubbers to remove the tar, water, and ammonia, and (previously to 1850) was then passed into purifiers containing lime to remove the sulphuretted hydrogen. The sulphuretted hydrogen combining with the lime in the purifiers produced sulphide of calcium, which is the only known agent for absorbing the other forms of sulphur required in the gas. The purifiers were worked in sets of four, three being at work and the fourth being charged with lime, and ready to be brought into action when the last or last but one showed at the outlet any trace of sulphuretted hydrogen; the fourth purifier, charged with fresh lime, was then put on last in the series." Then Mr. Patterson, assuming that he was the discoverer, said, I have reversed all that. Instead of throwing it out when it is sulphuretted hydrogen I throw it out when it is carbonate of lime; and he told them they had been on a wrong track, and, as Mr. Edison says in his specification, I have reversed all that practice. Whether it was Mr. Patterson's discovery or whether it was the discovery of Mr. Trewby, the manager of the company's works at Beckton, it was an exceedingly valuable discovery, because undoubtedly it did have the effect of raising the standard of purity. There could not be a question as to that. The figures were conclusive.

Mr. JUSTICE BUTT: Mr. Aston says you disclose your views now for the first time.

Mr. ASTON: I wish you had made that graceful concession before; it might have materially affected our position.

The SOLICITOR-GENERAL: There could be no doubt about that. The Court of Appeal held that it was Mr. Trewby, the gas manager's discovery, who had mentioned it to Mr. Patterson, and not Mr. Patterson's discovery, but they also expressed the opinion, which I am going to read to you, on the validity of the patent, assuming that it was Mr. Patterson's discovery, and they also decided that in the position he was in as gas referee it was not competent for him to patent it, and whatever knowledge he possessed belonged to the public. This is Lord Justice James's judgment: "The gas companies had failed to supply to the public a gas which did not contain a very considerable amount of sulphur, and not only was that amount excessive, but the gas showed, according to the plaintiff, variations in that amount from day to day which the makers could not account for. With the same coal, the same process of manufacture, the same purifying process, the gas came out sometimes very pure and sometimes very impure. Revolving these things in his mind, the plaintiff says that he discovered the cause of the defect, and with it a simple and effectual means of removing such cause. The discovery may be stated shortly thus:—After a certain preliminary process of purification in what are called washers and scrubbers, the gas, which was still very impure, containing a large quantity of carbonic acid, sulphuretted hydrogen, and other sulphur compounds, was passed through purifiers containing lime and oxide of iron. The oxide of iron would absorb and remove sulphuretted hydrogen, but had little or no effect on the other sulphur compounds. The lime was capable of absorbing the carbonic acid, and also the sulphuretted hydrogen, but had no effect, as lime, on the other sulphur compounds; but in absorbing the sulphuretted hydrogen it became a sulphide of calcium, in which state it was a very efficient agent for removing the other sulphur compounds. The lime was, therefore, capable, first as lime and then as sulphide of calcium, of removing the carbonic acid and the sulphuretted hydrogen, and to a great extent the other sulphur compounds. But the plaintiff, as he alleges, has discovered that a great chemical truth had been overlooked or neglected"—as Mr. Edison pretends in his patent—I will not say pretends, because that would imply he was saying something which he did not believe, and I do not mean to imply that Mr. Edison said anything he did not believe, though I shall point out that he deceived himself, that he thought he had discovered more than he actually had—"namely, that carbonic acid would decompose sulphide of calcium and set free again the sulphur which had been absorbed, and he therefore discovered what had been overlooked, that it was essential that the gas should be entirely deprived of its carbonic acid in the first instance. The lime in the subsequent purifier or purifiers would then be partly pure lime, partly sulphide of calcium. The lime would go on absorbing sulphuretted hydrogen until it became wholly sulphide of calcium, and the sulphide of calcium would continue taking up the other sulphur compounds. When this truth presented itself to the plaintiff's mind the remedy was very obvious. From the great affinity between lime and carbonic acid it is easy to absorb the latter, and practically speaking carbonic acid would not escape from a vessel containing lime unless and until the latter had been converted into a lime. Having satisfied himself by deduction and by experiments that the solution of the sulphur difficulty was to be found in the proper use of the affinity between carbonic acid and lime, he confidently informed his colleagues of his discovery, and, as alleged, it was with his permission that his lime process was given in the report next to be mentioned, and with a perfect understanding on their part that he was to take out a patent for his said discovery before the issue of the report." As Mr. Edison says he satisfied himself by experiments that the solution was in the proper use of the scientific law of resistance. Then his lordship discusses the report of the referees. Then, at page 833, he proceeds to the discussion of the patent itself. He says: "The specification of the patent claims five different matters. If one of them is bad, as there have been no disclaimers, of course the patent must fail; and the defendants insist that every one of them is bad." Then his lordship read the first claim. It is this: "The employment of sulphides of calcium in separate purifiers as a means of purifying coal gas from sulphur existing in other forms than in that of sulphuretted hydrogen." His lordship goes on: "There is really in this nothing but the enunciation of a chemical truth, that pure sulphides of calcium will absorb the sulphur compounds. The plaintiff believed that he had discovered that chemical truth, although it had been taught for many years in many books, and was well known to chemists. There is no invention of any particular process or means of employing the pure sulphide of calcium. If pure sulphide of calcium is to be used it must be used in some separate holder of it, and the thing holding it would be a separate purifier, and there is nothing therefore in any previous part of the specification to limit the universality of the claims to the employment of sulphides of calcium for the removal of sulphur in other forms than sulphuretted hydrogen. It is obviously impossible to support such a claim as that, which was plainly based on the plaintiff's mistaken idea that he had discovered that peculiar property in sulphide of calcium. Passing over for the moment the second claim, which has been the principal subject of controversy in evidence and argument, the defendants challenge absolutely the novelty and utility of the other three. The plaintiff so challenged has failed to produce any evidence that they are of the slightest value. The defendants' evidence is, in general terms, that they have been tried and abandoned." Then he discusses those: "The great controversy of fact and argument, as before stated, has related to the second head of claim, which is as follows: 'A method or system of employing lime purifiers in the manner hereinbefore described, whereby the contents of all the said purifiers, or of any required number of them, can be converted into sulphides of calcium, and also (if required) be maintained in that condition.' There is in that no suggestion of any new apparatus, of any new process. There is no device or scheme of any kind. Lime purifiers in succession were in general, in almost universal use, whenever lime could be freely used. The gas entered one, passed from that into another, and then generally, or sometimes, to a third; the gas partly purfied in the washers and scrubbers passed through the series of lime purifiers into an oxide of iron purifier. That was the process before, and that is to remain the process after and under the plaintiff's patent. What he claims to have discovered is, that if the carbonic acid, which is the first thing taken up by the lime, is not wholly taken up at the beginning and is allowed to enter the last purifier or purifiers, it, in fact, poisons the latter, decomposes the sulphide of calcium already formed, disengages the other sulphur absorbed by the sulphide, and of course fills the gas again with the sulphur impurities which had been removed. This is a very valuable working caution and direction, but it is impossible to make anything more of it than a working caution and direction. It really amounts to nothing more than a direction to be sufficiently liberal in the use of caustic lime in the first stage, and an instruction that the moment it is so far carbonated as not to arrest the carbonic acid, it should be removed, and a fresh supply of lime got. It may be a direction and instruction of the greatest possible value and utility, but it is utterly impossible to make such a direction and instruction, however valuable, the subject of a patent. It does not differ in principle, although it does differ enormously in scale, from a cook's instructions and directions as to the best means of manipulating articles of food." Now, my lord, I ask your lordship's attention to this: "How can an infringement of such a patent be predicted? Would it do to say, in the days of your uninstructed ignorance you allowed the lime to remain three or four days; now that I have taught you better you remove it every forty-eight hours? Could the court say in words (if not in words, could it in effect say) we restrain you from working your lime-purifying process in any such way as will not allow the carbonic acid to enter the last purifier in sufficient quantity to do substantial mischief, or in less quantity on an average than it used to in former times on an average? No one has a right to prevent a workman from using care to keep his tools in the most efficient state. No one has a right to prevent a manufacturer from cleansing his vessels and throwing away the useless contents whenever he likes, or to ask him his motives or intentions in doing so." Your lordship will at once see how I apply that. I say that in this direction to use filaments where carbon filaments of a larger sectional area had been previously used by other persons, Mr. Edison is doing no more than enunciating a well-known scientific truth, namely,

that if you desire to increase the resistance, the way to do so is to reduce the sectional area of your carbon conductors. He is doing nothing more than stating that scientific truth in the form of recommending the use of carbon, and it is not competent for him to claim a monopoly of using one particular size of carbon conductors; I cannot say carbon conductors of any particular flexibility, because he does not tell us what amount of flexibility he recommends, but carbon conductors which have a certain amount of flexibility, but which may differ infinitely in degree as to the amount of flexibility; when all the world had been previously entitled to use carbon conductors generally. My lord, I point out this to you, that there is no new process. These carbon conductors are to be utilised in precisely the same manner as they have been utilised by other manufacturers of incandescent carbon lamps, or for the matter of that of incandescent platinum lamps—precisely in the same manner as Mr. Lane-Fox proposes to use his incandescent lamp, namely, by passing the current of electricity through the platinum wires and then through the carbon conductors. There is no tittle of variation of the way in which the lamp is to be operated. The machine is there. The only difference is that you introduce a carbon conductor of a small sectional area, and for the purpose of argument I will say of a certain amount of flexibility, there being, as the witness told us, every variety of flexibility from a wood splint down to a hair. Flexibility depends principally upon the material, and not upon the sectional area, though of course a substance of small sectional area will be more flexible than a substance of larger sectional area. Now, my lord, if that be right, I venture to submit to you that Mr. Edison's second head of claim has disclosed nothing whatever for which he is entitled to claim a patent. Now, my lord, I wish to say a word or two about this question of flexibility which my learned friend's witnesses have introduced into this idea of a filament. The first observation I make is that in no dictionary which I have consulted, and I have consulted the Imperial Dictionary, Dr. Todd's edition of Johnson, and Roget's Thesaurus, can I find that a filament denotes flexibility, although it is quite true that if you get a thin substance of small sectional area you do as a matter of fact *prima facie* get greater flexibility.

Mr. JUSTICE BUTT: Has any one ever described a platinum wire connected with carbon as a filament in any specification or patent?

The SOLICITOR-GENERAL: I am not sure, but I will get my learned friends to look. Your lordship will remember that Mr. Swan described his burner as a filament.

Mr. JUSTICE BUTT: I do not forget that..

Mr. ASTON: In 1882. But in 1879 he called it a rod or stick.

The SOLICITOR-GENERAL: The word "filament" is used in several of these patents. For instance, in Harrison's patent, which has been referred to, he says: "I make flexible carbon or other metallised carbon of any required length by means of threads or filaments of silk, or other suitable material, which I coat with carbon." I am not sure whether that is the first place where it is mentioned.

Mr. ASTON: I believe it is, and the only one.

The SOLICITOR-GENERAL: And your lordship will remember Sidot describes the natural carbons which are deposited on the side of the retort as forming a filament. One of those will be exhibited to your lordship, and you will be able to judge of that. My argument is that, if all the world has the right to use carbon conductors of all kinds, a man cannot claim the monopoly of a particular carbon conductor, unless he himself describes a new process of making that carbon conductor. I hope to convince your lordship that the idea of flexibility as affecting the value of using carbon filaments—I am not speaking of the spiral—never entered into Mr. Edison's head. It may be an additional advantage, but my friends here say the advantage has been very much exaggerated; the purpose for which Edison recommended the use of the carbon filament was for the purpose of getting the high resistance, and for that alone. That I claim to be perfectly plain from a perusal of his patent, and that any advantage to be derived from the flexibility of the filament was not present to his mind. I am going to call your lordship's attention to the specification. "The object of this invention is to produce electric lamps giving light by incandescence, which lamps should have high resistance." That is the object. "The invention consists in a light-giving body of carbon wire or sheets coiled or arranged in such a manner as to offer great resistance to the passage of the electric current and at the same time present but a slight surface from which radiation can take place." I cannot help thinking, my lord, that what Mr. Edison had primarily in his mind was what he describes in his drawing, that is the spiral, but I quite agree that his claims go beyond that. "The invention further consists in placing such light-giving body of great resistance in a nearly perfect vacuum to prevent oxidation and injury to the conductor by the atmosphere." There was no invention in that, because that had been done by King and afterwards by the invention of the Sprengel pump, and had been described by various persons, and had, in fact, been done by Swan.

Mr. JUSTICE BUTT: Done by Swan alone; other persons had nibbled at it.

The SOLICITOR-GENERAL: It is described, my lord. King tells you you are to get as complete a vacuum as possible. The best vacuum known in his day was the Torricellian.

Mr. JUSTICE BUTT: There is something beyond that in Swan's. There is freeing the gases in the material itself and then pumping them out.

The SOLICITOR-GENERAL: That is not part of this patent. That is in Swan's patent, which they are suing upon, which is later in date than this. My friends cannot say that that is part of this patent, because they say Swan's patent of 1880 described that as a novelty.

Mr. JUSTICE BUTT: You say that the vacuum is as perfect a vacuum as can be got without Swan's process of taking out the gases from the carbon itself.

The SOLICITOR-GENERAL: I am anticipating a little what I am going to say about Swan's patent. Your lordship has perfectly in your recollection that Edison has in a previous patent described that process of getting rid of the occluded gases by running on the pumps, and no doubt Mr. Edison did have that in his mind when he used the words "a nearly perfect vacuum."

Mr. JUSTICE BUTT: That is what occurred to me.

The SOLICITOR-GENERAL: Then what becomes of Swan's patent?

Mr. JUSTICE BUTT: That is another matter. I am only dealing with Mr. Edison's patent. It has occurred to me, having regard to what he said before, when he spoke of a nearly perfect vacuum he must have meant a vacuum produced not only by the Sprengel pump but by running the pump, by which the occluded air was expelled, and so you get much nearer a perfect vacuum than before.

The SOLICITOR-GENERAL: Quite true. But your lordship will remember that Edison's patent, No. 2,402, in which he described that process, is not sued upon in this action, and all that he tells us is that you are to get as nearly perfect a vacuum as you can, by whatever means are known to science.

Mr. JUSTICE BUTT: All I meant to point out was, that no one except Swan and Edison himself in a former patent had dealt with that and described the sort of vacuum he is dealing with here.

The SOLICITOR-GENERAL: I am not certain of that, because you did get a practically perfect vacuum.

Mr. JUSTICE BUTT: I am not certain. Nearly perfect is what he says; never absolutely perfect.

The SOLICITOR-GENERAL: You could pump down to one-millionth of an atmosphere, and as long as the carbon conductor remained cold before the electricity was passed through it, the vacuum would remain what you and I call perfect; but then Swan found that when you pass the current of electricity through the carbon certain occluded gases, which were concealed (I do not know why they are called occluded) or retained or shut up in the pores or molecules of the carbon, were let loose by the heat and interfered with the vacuum which had previously existed, and deposited an amount of soot or carbon through the influence of the air. All he tells you here is, you are to have a nearly perfect vacuum, which is almost identical with the language used by King and Roberts. Roberts says it is to be enclosed in a vacuum not containing any oxygen or other matter which can cause combustion or destruction. For combustion you may read oxidation. "The current is conducted into the vacuum bulb through platina wires sealed into the glass." That is admittedly not new. It was described in Lane-Fox's patents, and was used by Swan. "The invention further consists in, the method of manufacturing carbon conductors of high resistance, so as to be suitable for giving light by incandescence, and in the manner of securing perfect contact between the metallic conductors or leading wires and the carbon conductor." If one paused here one would have supposed Mr. Edison thought his invention consisted in what I will call the spiral arrangement, in placing the light-giving body in a nearly perfect vacuum to prevent oxidation and injury to the conductor by the atmosphere, and in the method of manufacture. "Heretofore light by incandescence has been obtained from rods of carbon of one to four ohms resistance." That is a statement of fact, and that statement is not accurate, because Lane-Fox had pointed out that you could get a resistance of as much as 500 ohms, I think, and Swan's lamp, we know from Dr. Fleming, had a resistance as high as 500 ohms. "Heretofore light by incandescence has been obtained from rods of carbon of one to four ohms resistance placed in closed vessels in which the atmospheric air has been replaced by gases that do not combine chemically with the carbon. The vessel holding the burner has been composed of glass cemented to a metallic base." He was mistaken in that, but that was excusable. Not only had there been a description of glass tubes exhausted by a Sprengel pump and then sealed, but Mr. Swan had used that device himself, and had described it to two crowded audiences and to one other audience. "The connection between the leading wires and the carbon has been obtained by clamping the carbon to the metal. The leading wires have always been large, so that their resistance should be many times less than the burner, and, in general, the attempts of previous persons have been to reduce the resistance of the carbon." That is not true, because Lane-Fox was increasing the resistance of the carbon rods.

Mr. JUSTICE BUTT: He said in general.

The SOLICITOR-GENERAL: This is only a statement of fact. I should not contend for one moment that because the patentee makes an erroneous statement in his patent, if he has properly described a process which is new, he would not be entitled to his patent. I do not want to make any false point of that kind. "The disadvantages of following this practice are, that a lamp having but one to four ohms resistance cannot be worked in great numbers in multiple arc without the employment of main conductors of enormous dimensions; that owing to the low resistance of the lamps the leading wires must be of large dimensions and good conductors, or a glass globe cannot be kept tight at the place where the wires pass in and are cemented, hence the carbon is consumed, because there must be almost a perfect

vacuum to render the carbon stable, especially when such carbon is small in mass, and high in electrical resistance." There your Lordship sees he points out that the object at which he is aiming is to obtain a conductor of high resistance. "In the use of a gas in the receiver at the atmospheric pressure which, although not attacking the carbon, serves to destroy it in time by air washing, or attrition produced by the rapid passage of the air over the slightly coherent highly-heated surface of the carbon. I have reversed this practice." What is the practice? He has reversed the practice which he states, and no doubt believes, had been the previous practice to aid in getting a low resistance. "I have discovered that even a cotton thread, properly carbonised and placed in a sealed glass bulb exhausted to one-millionth of an atmosphere, offers from one hundred to five hundred ohms resistance to the passage of the current, and that it is absolutely stable at very high temperatures." Now, my lord, that is a very important statement. Of course I believe that he had discovered it, and it may very well be that he had discovered it although other people may have done the same, which, when several scientific minds are working in one direction, is not wonderful. But what is it he says that he has discovered? What he says he has discovered is the amount of resistance which can be obtained in that way. That is the only purpose, having regard to what I call the preamble of the patent, and having regard to that passage. He recommends the use of the thread on account of the high resistance. Now it is said that the high resistance is combined with flexibility, and that it is absolutely stable at high temperatures; but the latter depends on the vacuum, because he had told us previously that there must be almost a perfect vacuum to render carbon stable. What I want to point out here is, that what he is speaking of is, solely and exclusively, the resistance.

Mr. JUSTICE BUTT: I do not follow you there. I daresay I am wrong.

The SOLICITOR-GENERAL: And the stability.

Mr. JUSTICE BUTT: I am not thinking of that. I should have understood him to mean, you may get a conductor of high resistance in a comparatively perfect vacuum, but if you want stability you must have a nearly perfect vacuum.

The SOLICITOR-GENERAL: Yes, my lord, I agree in that. I did not make myself clear. I was endeavouring to show that flexibility was not one of the ideas which was present to Mr. Edison's mind in recommending a carbon filament. Now flexibility nobody says, and nobody could say with truth, has anything to do with resistance. The amount of resistance, other things being equal, that is to say, the electromotive power being equal, depends exclusively on the sectional area of this cotton thread which he said he had carbonised. In speaking of a filament apart from a spiral, flexibility is not one of those things which he aimed at, or which he thought essential, or connected with the use of the word filament. He begins by saying that the object is to get a lamp of high resistance, then he goes on; and now we come to the coil. "If the thread be coiled as a spiral and carbonised, or if any fibrous substance which will leave a carbon residue after heating in a closed chamber be so coiled, that as much as 2,000 ohms resistance may be obtained." That is telling the world through this specification the amount of resistance which he had discovered might be obtained by the use of a carbonised cotton thread or by a coil or spiral, and that resistance is dependent exclusively on the sectional area; it is to that advantage he is directing attention and not to any subsidiary advantages if there be any, from the greater flexibility which a filament has. Then he goes on to describe what I own was a particular method of making his coils by a compound of lampblack and tar. He is still speaking of the spiral. He says: "I sometimes roll a thread within the compound of lampblack and tar so as to allow of greater convenience in handling the same, and the flexible carbon filament is not so liable to crack by its own weight in the act of winding." That relates entirely to the spiral, and of course for the purpose of forming the spiral it would be essential that the material used should be more or less flexible. With that we come to line 18: "To do this it is better to have the carbon as homogeneous as possible and obtain the requisite resistance by employing filaments several inches long, and winding the same in a spiral form, so that the external radiating surface should be small." Now, he says he has discovered about using the plastic lampblack, and it was as a cement for making his joints. "When fibrous materials are used the plastic lampblack and tar is employed to secure it to the platinum wires before carbonising. By using the carbon of such high resistance I am enabled to use fine platinum wires for leading wires"—pointing to the high resistance as being the advantage which he contemplates obtaining from the use of his carbon wires. Then he recurs to the subject at line 39, and says: "I have carbonised and used cotton and linen thread, wood splints, paper coiled in various ways, also lampblack, plumbago, and carbon in various forms mixed with tar and kneaded so that the same may be rolled out into wires of various lengths and diameters. Each wire, however, is to be uniform in size throughout. If the carbon thread is liable to be distorted during carbonisation, it is to be coiled between a helix of copper wire. The ends of the carbon or filament are secured to the platinum leading wires by plastic carbonisable material, and the whole placed in the carbonising chamber." Your lordship observes from these materials which are given us there, that, so far from having flexibility present to his mind as an advantage to be obtained, he gives you a choice of materials, or mentions the use by himself of materials varying in almost every degree of flexibility. I ask your lordship to come to the conclusion on reading this specification that the object and idea which Mr. Edison had present to his mind in the use of the filament *per se*, that is, not in a spiral form, was simply the high resistance which he thought he had discovered that he would get; and that, therefore, the only idea connected in his mind with the term filament, as used by him, was a filament with a sufficiently small sectional area or cross-section to give a high resistance, and that any incidental advantages which were to be derived from the greater flexibility, or were intended to be pointed out, were purely accidental, and were not connected by filament as used by him. I also call your lordship's attention to the fact that he does not confine himself to any size whatever—any size either of length or diameter. They may be of any length or any diameter; and, of course, my learned friends will say that it will still be a filament; but I have already given your lordship my submission that that is too vague, that that is not sufficiently definite in order to found a patent upon. There are various subsidiary points which I shall deal with very shortly on Edison's patent. In the first place, my submission to your lordship is that Mr. Lane-Fox having described an incandescent lamp precisely similar to this of Edison's, and working in the same way, and aiming at the same advantages of high resistance with a thin metallic conductor, there was no invention in substituting for the thin metallic conductor a thin conductor of another material which was well-known to be suitable for the purpose; that, in fact, you cannot have a patent for substituting one well-known material for another. The patent of Lane-Fox to which I allude is No. 4626, of 1878: "In order to obtain light from an electric current I make use of a sheet of platinised or iridised or carbonised asbestos or other suitable material, and in order to preserve the incandescent substance in a good condition and to prevent its deterioration, I enclose the whole in a glass or other suitable transparent vessel or cover through which the platinum supports are fused." Then he goes on: "When platinum, iridium, iron, or other metal is used, either pure or alloyed with some other material or materials, and either blown or covered with some suitable material, such as powdered asbestos, magnesia, or a vitreous substance, I prefer to coil a long strip or wire into the form of a spiral, and to attach the two ends to platinum wires fixed side by side by fusing into a piece of glass or otherwise, so that they run parallel to one another, one wire carrying the top of the spiral and the other the lower end. The length and thickness of the spiral will depend on the intensity of the light required and the electromotive force available." In a previous patent we have the law already enunciated that if you wish a lamp of high resistance, you must reduce the thickness of your spiral and increase its length. "The ends of the spiral should be united to these wires with some hard solder. This string is then enclosed in a globular or flask-shaped glass vessel whose neck is sufficiently large to admit it, and the neck should then be closed up around the two supporting wires so as to seal them in and make the whole vessel air-tight."

Mr. JUSTICE BUTT: You say that is the lamp, except that the burner is platinum and not carbon. It is true he goes on to deal with carbon burners, but that is an arc or semi-arc lamp. The first part describes a lamp, it seems to me, very similar to this, except that the burner is of metal and not of carbon.

The SOLICITOR-GENERAL: He says when platinum, iridium, or other metal is used. My submission is that carbon being at the date of this patent, and certainly long prior to Edison's patent, a well-known substance for making the burners of incandescent lamps, there could be no invention in substituting one well-known substance for another. That, again, has been the subject of decision, and the decisions have been entirely uniform. If it was well known to the world, as it was well known after the publication of Lane-Fox's patent, that a lamp might be made in this form with a metallic conductor, and if it was well-known, as undoubtedly it was well-known from the time of King, that carbon was a good material for making a conductor of an incandescent light, then there could be no invention. There are several cases upon that point, and perhaps as good a one as any is the case of Horton *v.* Mulliver, which is reported in 12 Common Bench New Series, page 437, and before the Exchequer Chamber in 16 Common Bench New Series, page 141. "This was an action for an alleged infringement of the plaintiff's patent for improvements in the construction of gas holders. The plaintiff claimed damages and also an injunction and an account. The defendant pleaded, first, not guilty; secondly, that the plaintiff was not the first and true inventor of the said supposed new manufacture as alleged; thirdly, that the said supposed invention was not a new manufacture as alleged; fourthly, that Her Majesty did not by the said Letters Patent make such grant as alleged; fifthly, that the plaintiff did not within six calendar months next after the date of the said Letters Patent cause to be enrolled in the Court of Chancery an instrument in writing under his hand and seal, particularly describing and ascertaining the nature of the said invention, and in what manner the same was to be performed, as alleged." The Chief Justice said this: "The whole claim of the plaintiff consists in the application of a known article to a purpose analagous to those to which it had before been applied; and that in my opinion is not a proper subject of a patent." In the Exchequer Chamber, Chief Justice Cockburn says: "We are all of opinion that the judgment of the Court of Common Pleas ought to be affirmed. That which the plaintiff claims as part of his invention is the substitution of double angle iron for two pieces of single angle iron in the formation of hydraulic cups or joints to telescopic gas holders. Now, it was matter of general knowledge that the cups might be formed by rivetting two pieces of single iron to a plate, and we agree with the Court of Common

Pleas in thinking that the mere substitution of double angle iron —an article well known in the trade—is not an invention for which a patent can be granted." I say in the same way, that substituting a fine carbon wire for a lamp with a metallic wire, in which, Lane-Fox tells you, the length and thickness of the spiral will depend on the intensity of the light required and the electromotive force available, is not the subject matter for a patent; it is the mere substitution of one material for another well known for this very purpose. My next point is this: Mr. Edison tells you in the preamble of his patent that he conceives that part of his patent consists in a method of manufacturing carbon conductors of high resistance so as to be suitable for giving light, and I suppose that in his first claim he means to claim the method of manufacture, but united also or in combination with the method of securing the joints. What is the method which he has described? It is, first, cotton thread, properly carbonised. Well, my lord, that there is no novelty in. But it may be that his patent might be supported as describing a mode of manufacture, if it were a new application to a new purpose. But then there is this objection, if my friends rely upon it, and they seem to rely upon it, as reading the first claim to be a claim for the method of manufacturing carbon conductors described by Mr. Edison; then it appears to me they are in this dilemma, that he has not described, except with regard to the spiral and the lampblack and tar, any new method of manufacturing the carbon conductors. He has only told us that it is to be properly carbonised. Or else he must be taken to have described a method of manufacturing the carbon conductors, consisting of properly carbonising them in a chamber, but in that case he is in this difficulty, that it is the duty of every patentee, as has been said over and over again by various judges, to tell the world at the date when he files his final specification of the best means he knows for carrying out the object which he describes. If his patent be for a new method of manufacturing, if between the provisional specification and the final specification he discovers an improved mode, or what he considers to be the best mode of carrying out his patent, he is bound to give to the public the benefit of that information. There cannot be any doubt about that principle. In "Bovill *v.* Moore," which is reported in Davis's Patent Cases, page 361, Lord Chief Justice Gibbs thus directed the jury: "There is another consideration respecting the specification, which is a material one, and that is, whether the patentee has given a full specification of his invention, not only one that will enable a workman to construct a machine answering to the pattern patent, but one that will enable a workman to construct a machine answerable to the extent most beneficial within the knowledge of the patentee at the time. If Mr. Brown since he obtained his patent has discovered an improvement, he may apply that improvement, and his patent will not be affected by his using his own machine in that improved state; but if at the time when he obtained his patent he was apprised of this more beneficial mode of working and did not by his specification communicate this more beneficial mode of working to the public, that will have been a fraudulent concealment from the public"—I am not responsible for the hard language; fraudulent in a Pickwickian sense, perhaps it means—"and that will render his patent void."

Mr. JUSTICE BUTT: He used strong language there, and I should think the object of his using strong language is that he is putting it to the jury and thinks they will flinch from that, and that that is a way of getting a finding in accordance with his own views.

The SOLICITOR-GENERAL: He was more experienced in the ways of juries than I am. But without using any strong language, the principle is perfectly clear, that at the time when he files his final specification a patentee is bound to give the public the best means he knows at the time of carrying out his invention, and that he is not entitled to put before them a vague general description like this.

Mr. JUSTICE BUTT: I want to follow you here. You have said on this second head, the process of carbonising is not new, that it is a matter of common knowledge. But you say it may be contended that the invention consists in the application of that to the lamp, and then that he does not describe how to apply it properly. Is that so?

The SOLICITOR-GENERAL: Yes. I am afraid I did not express myself quite accurately on this point. He, under his first head of claim, claims a new method of manufacturing carbon conductors. His only description is that you are to take a cotton thread and properly carbonise it, or that you are to take a fibrous vegetable material and carbonise it in a closed chamber. If he had at that time in his possession, and within his knowledge, a superior mode of carbonising a cotton thread, which would make it more suitable for the purpose of a carbon conductor, then he was bound to give the pubic the benefit of his knowledge. In Plumpton *v.* Malcolmson, reported in the Law Reports, 3rd Chancery Division, at page 576, there is a dictum of the Master of the Rolls, which I will read: "The next objection was this, and it is an objection well-founded in law, if it is made out—that the patentee is bound, not only to tell the public enough to make the invention useful, but to show the most convenient form of performing it within his own knowledge." Your lordship was told, and Mr. Aston was very anxious to keep back the knowledge of it, or at any rate he did not appear to like its being referred to, that Mr. Edison applied for further Letters Patent on December 15th, 1879, which was only a little more than a month after he had applied for these Letters Patent, and long before he put in his final specification on May 18th, 1880.

Mr. JUSTICE BUTT: A patent for the manufacture of this filament?

The SOLICITOR-GENERAL: Yes. "In a formal application made by me for Letters Patent in Great Britain of improvements in electric lamps," &c. I observe there, my Lord, that he calls that strip of paper, which is flexible in a vertical direction, though not horizontally, a filament.

Mr. JUSTICE BUTT: Is that a provisional specification?

The SOLICITOR-GENERAL: Yes. It went on to a final specification, and it is now an existing patent. He shows in the drawings the means which he proposes. He there discloses what he conceives to be the best mode of making these carbon conductors, and my suggestion and submission to your Lordship is that, according to the plain rules of law, he was bound, when he took out the final specification for his previous patent, instead of merely saying at large, "This is to be properly carbonised," if he knew one method of carbonisation which was superior to another, he should have communicated that to the public.

Mr. JUSTICE BUTT: I have not caught yet that this process has been followed in the lamps handed up. Why cannot he say, after all I do not think that is the best now?

The SOLICITOR-GENERAL: He does say it. Sir Frederick Bramwell, I think, said that instead of using cardboard he used bamboo strips to carbonise in the mode described. The point of the patent was the mode of carbonisation. I believe, if your lordship desires it, we can give evidence that this has been used, and I am not concerned to say that it is not a very good mode of carbonisation. I believe your lordship is quite right. He does not use cardboard now, but he uses strips of bamboo. I suppose he has tried various materials and found strips of bamboo preferable. But at any rate this is what Mr. Edison conceived to be a great improvement at the time; he may have discovered greater improvements since. Sir Richard Webster alluded to this point in his opening, or in the course of the many interlocutory observations that fell from counsel in the course of the examination of witnesses. How did they deal with it? They said, "Oh, but he did give the public the benefit of it, for he took out a patent for it, and thereby the public did get the benefit of it." That is no answer at all. In the first place, if we wish to be highly technical, he got 45 days more protection for this improved method than he would have got if he had put it into his earlier specification. There is, however, another answer, which is an answer of substance. If the law be as I conceive it is, that the patentee is bound to give the public, at the price of the monopoly which he obtains, the best means of carrying out that invention for which he obtains the monopoly, then if he puts it into another patent, he imposes upon the person using the first patent the obligation of taking out two licenses. It is not sufficient for him to take a license under the first patent, because that will not enable him to use it. But the law says a man ought in the same patent to give you the benefit of the whole of his knowledge; that he is not to dribble out his knowledge in a number of different patents, but that when he states, in compliance with the conditions of the Letters Patent, the mode in which the invention is to be carried into effect, he is bound to state, quite irrespective of the question whether he has applied for another patent or not, the best mode in which that can be carried into effect. That, of course, only relates to the first claim. The first claim, according to my learned friend's interpretation, is a claim for a new method of manufacturing carbon conductors; but if it be a claim for such a new method, then I say he has not complied with the requirements of the patent law by giving the public all the information which was within his knowledge as to the mode in which the invention could be carried out at the date of his final specification. The petition I take up with regard to the second claim is, if it bears the construction on the assumption of which I have been arguing, namely, that it applies to carbon filaments of every shape, every mode, of whatever description, to everything that can be described as a carbon filament, then I know that my clients do make some small lamps in that way. They make lamps of all sizes from the size of a pea upwards. I had a beautiful little lamp put into my hand the other day which is intended to be used for dentistry, or something of that kind. There are lamps of all sizes, and undoubtedly my clients do make lamps in which, according to my construction of the word filament, you could describe the burner as a filament. But I am instructed to deny in the most explicit manner that these filaments are made in any mode, or in a manner resembling any mode, which is described by Edison. I will tell your lordship candidly the position I am in. I desired, and my clients have been good enough to comply with my desire, that I should be told in confidence what the methods were; but I have been only told in confidence. I have been told the method in which they make it, and, in their opinion, it is an extremely valuable secret, because they attribute their commercial success in the manufacture of these lamps, such as it is (I am not going to brag about it), to the excellence of their burners, and they say if they are compelled to reveal this secret, which is their own property, to the world at large, they will lose more than half the commercial advantage which they consider they have over their competitors. In a case with which my learned friend Mr. Aston is acquainted, in which I had the disadvantage of being against him, although I think I was on the winning side, that is, the Nickel Plating Company *v.* Farquaharson, exactly the same thing arose, only it came on as a motion before the Master of the Rolls by the plaintiff, for whom, I think, Mr. Aston appeared, that he might be at liberty to inspect that process, which in the ordinary way would be a matter of course. What the Master of

the Rolls did in that case was this. He quite recognised the cruel hardship of a person being made to reveal a trade secret which is part of his advantage over his competitors, for the purpose of defending himself against an action for infringement, and what he did I think there was some precedent for—he appointed a person as referee to examine the process and to make a sealed report to the judge on the result. I believe it turned out at the trial that the process was something totally different from that which the plaintiff claimed. I am quite willing that your lordship should do that in the present case, and if your lordship could induce the learned judge Mr. Justice Grove to look at it, we should be only too delighted. We would not propose that he should be made a referee, but if he could be induced to come and see it, we should accept his opinion. I should be perfectly willing that Dr. Hopkinson should do it, except for this reason, that looking through the notes of his evidence, we found that he says he has acted as adviser to the Edison Company, and the knowledge he thus obtained might embarass him.

Mr. ASTON: If at all, I think it should be by some independent person; but your lordship will hear me upon that presently.

Mr. JUSTICE BUTT: Was it the late Master of the Rolls, Sir George Jessel?

The SOLICITOR-GENERAL: Yes, my lord.

Mr. JUSTICE BUTT: Was it done by consent?

The SOLICITOR-GENERAL: No. I appeared for the defendant. I had affidavits that it was a trade secret which he considered to be of great value, and which he was unwilling to reveal unless he was compelled to do so. One sees at once the hardship which is put upon a man under these circumstances.

Mr. JUSTICE BUTT: Yes. Of course there must be something on oath to found it. I presume you would call your client?

The SOLICITOR-GENERAL: Yes. I only wish to take the earliest opportunity of dealing with it.

Mr. ASTON: In the Badische case the same question arose, and his lordship there said that the defendant would please himself as to whether he took the course which was open to him of stating whether his invention was what the plaintiffs alleged it to be or not, and in that course his lordship intimated: "I am satisfied upon the statements of the plaintiff's witnesses that as far as they go they are correct, and I shall assume that they are correct unless my mind is dispossessed of that idea.

Mr. JUSTICE BUTT: Was that an application to refer it to somebody?

Mr. ASTON: No.

Mr. JUSTICE BUTT: Of course, if *prima facie* evidence is given of an infringement, and the defendant does not get into the witness box to state what his *modus operandi* may be, then that which is merely a *prima facie* case becomes an absolute case, or something like it. That is the general rule. But if the defendant gets into the witness box and says: "I deny the infringement, and am prepared, and shall be prepared, if driven to it, to show on my oath what my material or my combination is; but I shall ruin my trade if I do so, and, therefore, having stated on oath preliminarily that it is a secret, I ask for a reference ——"

The SOLICITOR-GENERAL: And denying that it is anything described in the patent.

Mr. JUSTICE BUTT: I say, denying that it is an infringement. That must be on oath of course. I could not entertain the application for a moment without that.

Mr. ASTON: When that arises your lordship will deal with it in such a way as your lordship thinks right.

The SOLICITOR-GENERAL: I only mention it because I wish your lordship to be in possession of my view at once. It may turn out to be immaterial, because if the patent is good I cannot deny that I use a carbon filament made in a closed vessel. But then so does every other incandescent lamp maker in the world. But I do deny, and I am instructed to deny, and I feel justified in denying that these filaments are made in any mode resembling that described by Edison in his patent.

Mr. MACRORY: Perhaps we may go so far as to say in either patent.

(To be continued.)

REPORT ON THE UPWARD PRIMARY BATTERY.

To MESSRS WOODHOUSE AND RAWSON,

Gentlemen,—I have carefully and minutely examined the chlorine battery of Mr. Upward, and beg to report that it is constructed on sound scientific principles, and that it fulfils most of the requirements of a good primary battery for practical electric lighting work. So far as I am acquainted with other primary batteries at present in the market I should decidedly recommend it in preference to them. The application of a free gas to consume the zinc of a battery, and thus to maintain a constant and high electromotive force is, so far as I am aware, new, and the details are carried out with great ingenuity and success.

The elements of the battery are, zinc immersed in a solution of chloride of zinc contained in a porous vessel on the one hand; and crushed carbon immersed in gaseous chlorine and kept moist by the deliquescent action of the zinc chloride which oozes through the porous pot into the outer vessel, on the other. The outer vessel is allowed constantly to drain so as to never contain any loose liquid: it is only intended to contain as much as will keep the carbon properly moist. When the circuit is closed, zinc dissolves and chlorine is taken up in precisely equivalent proportions, and when the circuit is open no chemical action occurs; the zinc being entirely unattached, and all chemical action being in abeyance except when a current passes. The solution in the inner vessel tends to become stronger as the battery is worked, the chloride of zinc needed being generated by the battery's own action; so if loss of fluid be made up by addition of plain water it is possible to keep the solution at a reasonably constant strength. The deliquescent property of zinc chloride prevents any difficulty with crystallisation and creeping. If the battery is in regular work it should give little or no trouble, and even if it stand idle for long the only change is that the liquid in the porous cells either falls in level or else becomes more dilute. The running to waste of the zinc-chloride solution may, however, be checked before leaving the battery to stand, and in that case the cells are easily replenished again. No mixing of solutions can occur as there is only the one liquid and there is no electrical waste on standing, for as soon as the supply of chloride is exhausted the battery stops working. The E.M.F. of the battery is from 2 to 2·1 volts, and it is extremely constant so long as a free supply of chlorine is maintained. The arrangements for the supply of chlorine are perhaps the most striking parts of the invention. The gas when made is stored in an admirable and simple form of holder which can give no trouble at all, and which stores the gas without waste and without corrosion. It is easy to tell by inspection whether it is full or empty and how much gas it contains. From the holder the gas passes through lead pipes to the series of cells into which it is drawn by their own action in a constant stream while they are working. At intervals, however, a supply is needed for a short time greater than what the mere absorbing power of the carbon can provide; whenever this happens a very beautiful automatic arrangement turns on a small water aspirator and sucks in the necessary extra gas. This part of the apparatus may be taken as almost perfect or likely at once to become so. The obvious question of smell suggests itself, but it will be found that the battery and the gas holder are so well sealed up that from them there is practically no smell at all. Any slight excess of unconsumed chlorine which the water aspirator may suck through—and it is very slight, for the aspirator only acts for a minute or so at a time and rests for an hour or more—is at once carried down into the drains where it must do the reverse of harm.

There remains the chlorine generator. The making of chlorine is with ordinary apparatus an outdoor operation, and it is the only part of the whole affair which involves any trouble. But with the apparatus now in use it is a process able to be performed by a boy, and there is reason to believe that it will be further improved. The frequency with which the manufacture has to be performed depends simply on the demands of the battery as compared with the size of the gas-holder, and by the use of a sufficiently large holder it is possible to arrange so as only to make chlorine once a week, or it may be made in smaller quantities every day, without much trouble and wholly without skill, so soon as this part of the arrangement is perfected. The internal resistance of a cell, as now constructed, is rather high, being about a quarter or a fifth of an ohm. This is a distinct disadvantage, as it renders the battery non-self regulating when working by itself, but the patentees have evaded this objection by combining with it a secondary or storage battery of about half the number of cells; these constitute the real source whence the external circuit is worked, and of course they are perfectly self-regulating, so that whether one lamp or 30 are lighted, the change need make no difference to the potentials of the terminals, and therefore to the brilliancy of the lights. The function of the primary battery is thus simply to keep the storage battery always full. At first sight this seems a roundabout mode of achieving a given result, but on inspection it turns out that a good deal can be said for it, and under the circumstances it is the correct way to work. The arrangement is at once comparable as to the use of gas engine and dynamo to charge accumulators; but advantage lies on the side of the primary battery, in its silence and quiet pertinacity of charging without the least attention. The primary and secondary batteries are never in practice disconnected. So soon as the secondary is full the primary slackens, and chlorine is drawn into it less quickly. Directly the secondary is drawn upon, the primary at once begins to make up the deficiency, and its activity varies with the demand made upon it. No back current can ever be formed, and the constant filling and occasional overfilling of the accumulators is exactly the condition under which they are known to work best and last longest. Accumulators so charged are, in fact, in quite the most favourable circumstances, and may be expected to give no trouble. The virtual power of the primary is, of course, by this arrangement, enhanced, since it may take all day to replenish the loss of a few hardworking hours, so that a battery for given dimensions and prime cost is enabled to run a larger number of lamps than if it were only working during lighting hours. Moreover, the use of accumulators enables the battery to work often at more moderate activity, instead of always straining at its maximum output. When the battery is properly and finally set up it may be trusted to work quite regularly, and without attention day and night, so long as the chlorine is made when required, and so long as fresh water is added both to the primary and the secondary cells. This last operation, the addition of water, is a very simple one, and it may perhaps be made automatic, in which case there will be nothing to see to but the manufacture of chlorine whenever the store in the gas holder gets low. Finally, there is the

question of cost. In some cases this is the most important of all; in other cases it is less important than the question of noise and trouble. I apprehend that it is under these last circumstances that the battery is likely to be most in demand. The main first cost of an installation consists of the cells, of which two primary and one secondary are needed for every couple of volts demanded in the circuit. The working cost is made up of zinc, chlorine, and attendance. The last item may be treated as negligible in any house where a boy or man is already kept.

Cost of Zinc.—1·2 grammes of zinc are dissolved in each cell per ampère hour. When the battery is working at full power this means 1,200 grammes of zinc per 1,000 watt hours; when it is gently maintaining the charge of a full accumulator it means little more than 900 grammes of zinc per 1,000 watt hours; but, inasmuch as something is lost in storage, we can hardly reckon less than 1¼ kilogrammes, or 3·3 lbs. of zinc consumed altogether, per 1,000 watt hours actually used.

Cost of Chlorine.—Every 10 lbs. of zinc requires 11 lbs. of chlorine to combine with it. The waste of unconsumed chlorine is very small, and may be safely neglected. Hence we may consider that every 1,000 watt hours requires 4 lbs. or 23 cubic feet of chlorine gas. The price of this quantity of chlorine depends entirely on the method of manufacture adopted. By the best known laboratory method it is rather high since the production of each pound of chlorine would need some 6 lbs. of commercial muriatic acid, and 2 lbs. of commercial manganese. The common salt and sulphuric acid method is a little cheaper, but not much.

On the whole then it is manifest that the use of the battery is distinctly more expensive than direct gas lighting, and than gas engine and dynamo; but under circumstances where electric light is required, and where the noise and trouble of a gas engine and dynamo are out of the question, I apprehend that the Upward battery may serve as a very useful substitute, and that in this field it has a distinct function.

The patentees claim for their battery certain advantages which, as specified below, I hereby substantiate.

1st. So long as the battery is in regular work, and provided the porosity of the cells has been properly adjusted, to begin with, nothing but plain water has to be added occasionally to the battery, and no emptying and filling of cells with acid or corrosive liquid of any kind is required.

2nd. The plates are never touched or moved from the batteries from the time the zincs are put in till they are consumed, which may be about once a month of usual electric lighting work.

3rd. When the battery is at work the zincs are consumed uniformly down to a thin wafer, thus using the whole plate without waste, and enabling all the plates to be renewed on the same day. This equable wear of the plates is an important point, and it is not a matter of accident; it is due to the fact that the same current passes through every cell, and to the absence of local or irregular action.

4th. The carbon plates are once for all sealed into their places and never removed.

5th. There is no creeping, and consequently the terminals do not corrode.

6th. There is no polarisation, and the E.M.F. is constant.

7th. There is no local action, and when idle the zincs are not at all corroded; they may stand in the solution unaffected for any length of time. The consumption of materials is simply proportional to the current drawn off, and ceases altogether when the circuit is open.

8th. No removing of the plates for amalgamation is necessary, nor is there any expense or trouble with mercury; ordinary commercial zinc cast in plates without any amalgamation being used.

9th. No washing of porous pots or other parts of the battery is required.

10th. The battery is mainly self-acting; all that is wanted is to supply the cells occasionally with water and to make the chlorine, a process which by special design of generator is rendered simple.

11th. The light is available at any time of day or night, and it is perfectly steady.

12th. The high E.M.F. of 2·1 volts is that due to the direct action of chlorine upon zinc, and no third substance or "depolariser" is used at all.

13th. The battery is of a permanent nature. The whole primary battery apparatus may be left standing for months without depreciation, and can be started by filling up the pots and admitting the gas.

14th. There is no smell, dirt, or fume from the cells or from the gas-holder.

15th. The arrangements for storing the chlorine, and for its automatic supply to the cells as required, are exceedingly satisfactory and ingenious.

Finally, I may say that I have given much time and taken extreme pains to lay before you a report that shall be as fair as possible both to the public and to the inventor; and I think I may congratulate Mr. Upward upon the energy and perseverance with which he has tackled and overcome one difficulty after another, and so developed from a somewhat unpromising beginning a really practical and successful primary battery.

Signed by me as expressing my matured opinions on the Upward Chlorine Battery in its present stage, this twenty-fifth day of June, eighteen hundred and eighty-six.

(L.S.) OLIVER LODGE.

University College,
Liverpool, *25th June*, 1886.

LEGAL.

United Telephone Company v. St. George.—This was an action tried before Mr. Justice Stirling last week to restrain the infringement by the defendant, Mr. Arthur French St. George, of 85, Chancery Lane, London, of the Edison patent numbered 2,909, and dated July 30th, 1877, for "improvements in instruments for controlling by sound the transmission of electric currents and the reproduction of corresponding sounds at a distance." The plaintiffs alleged that the defendant had infringed the patent since August, 1882. Mr. Micklem was for the plaintiffs; the defendant appeared in person. Dr. Hopkinson, Mr. Imray and others gave evidence in support of the plaintiffs. The defendant did not raise the question of the validity of the Edison patent, but argued that his instrument did not infringe it, calling evidence to show that his transmitter acted by reason of a rapid succession of makes and breaks of current. The diaphragm in the alleged infringement consisted of a disc of compressed leather carbonised; a ball of hard carbon suspended by string and resting against the disc was the alleged tension regulator. Defendant contended that when the instrument was spoken to the disc was set in vibration and kicked the carbon ball from it, the latter never returning with precisely the same point in contact. In proof of this, evidence was given of a mark as of constant friction extending equatorially, in some cases half way round the ball. His lordship gave judgment for the plaintiffs on Saturday, declining to accept the view that there was a make and break of current in the instrument. The evidence of the plaintiffs was not inconsistent with a rolling of the carbon ball such as might produce the mark alluded to, but the term rolling (which was also the term used by the defendant) was incompatible with discontinuity of contact. The learned judge, in the course of the delivery of his judgment, animadverted upon the conduct of the defendant when under cross-examination by the plaintiffs' counsel.

NOTES.

A Step in the Right Direction.—The Anglo-American Brush Electric Light Corporation has notified that it is prepared to indemnify all users of its incandescent electric lamp, known as the "Victoria" lamp, against proceedings for any alleged infringement in those lamps of the patent rights of other manufacturers.

Navigating the Suez Canal by Electric Light.—At the monthly board meeting of the directors of the Suez Canal Company, last week, M. de Lesseps stated that the authorisation given at the beginning of the year for vessels provided with the proper electric lights to continue their passage through the Suez Canal by night had been productive of very good results, as the traffic had thus been sensibly relieved. The postal steamers of the Peninsular and Oriental Company, which have adopted the system of electric lighting, now passed through the canal in 20 hours, whereas the average time spent by these vessels in getting through the Canal before night navigation was permitted was 30 hours.

Electric Lighting in the United States.—The electric lighting company at Salem, Mass., expects to get the contract for lighting all the streets of the town with arc lights. The company already has 115 arc and 140 incandescent lights in use, the system being the Thomson-Houston. Two engines furnish power for the plant, a 75 H.P. Fitchburg and a 60 H.P. Hawkins.

The Edison Electric Illuminating Company has commenced the lighting of the entire city of Lawrence, Mass., with the Municipal system of incandescent lighting. The company has 3,500 incandescent lamps in use in domestic installations in the city, all giving thorough satisfaction.

An extensive system of electric lighting was inaugurated last month at the picturesque little town of Wayne, about 14 miles from Philadelphia. The Citizens' Association of Wayne has determined upon the general development of the place, and has constructed, at a cost of $20,000, an electric light plant with a capacity for furnishing 1,300 lights. About 800 lights have been subscribed for and are in use. Not only is nearly every house at Wayne illuminated by Edison incandescent lamps, but all the streets and the railway

station likewise, the surplus capacity being left for the growth of the place. "Ordinary sized" cottages are said to be each furnished with 16 C.P. lamps to the total of 100 C.P. for $30 a year, while 32 C.P. lamps to the total of 200 C.P. are placed in the larger dwellings for $50 a year. It is proposed to extend the system to many other small towns in the neighbourhood.

It is claimed that Philadelphia has the cheapest electric lights of any important town in the United States, excepting Rochester, where water power is used. The prices paid range from 45 cents. in Rochester per lamp per night to 91 cents. in Los Angeles, Cal. Rochester is the only place supplied for less than 50 cents. Philadelphia pays from 48 to 59½ cents.

At Greeley, Col., there is a plant of two Brush incandescent dynamos, two Armington and Sims engines, Lowe feed-water heater, boilers set with Jarvis furnaces, &c. All the machinery is duplicated, and by means of a large switch board all the circuits can be changed from one dynamo to the other, in case anything happens to either. The plant is situated in the centre of the town, and the mains extend in all directions to a distance of over 2,500 feet from the station. The light is being adopted throughout the entire city; churches, stores, and all public buildings are brilliantly illuminated. The city is putting in large 150 C.P. incandescent street lights, as they are preferred to arc lights for general use. Many of the private residences are enjoying the electric light, the lamps in use in the city being the Swan 16 C.P. and the large Westinghouse lamps.

Electric Lighting in Brussels.—The Central Post Office at Brussels is now lighted by two arc lamps, two sun lamps, and a large number of incandescent lamps. The Electric Company has put down an extensive steam and electrical plant in the Rue Zerezo, near the Northern Terminus, for lighting, with Lane-Fox incandescent lamps, a whole quarter of the city. At first each house or café lighted will form the subject for a separate contract; but it is hoped that by next year the number of customers will have so far increased as to permit a current being charged by meter.

Engines for Electric Lighting.—Messrs. Bollinckx, of Brussels, have lately supplied for electric lighting an engine of 46 I.H.P., horizontal compound, with intermediate receiver, and with the admission valves controlled by a Watt governor, with very heavy balls, which they find the most suitable for the purpose.

Incandescent Lamp Patents in America.—The New York *Electrician and Electrical Engineer*, after giving a *resumé* of the decisions of Mr. Justice Butt in the cases respecting incandescent lamps recently before him says: "The publication of these decisions has excited considerable interest in electric lighting circles in this country, and many inquiries have been made as to their effect upon the status of the present and prospective litigation in the United States relating to the same subject. So far as the Edison patents are concerned, it may safely be said that the decision can have no effect whatever. In a carefully prepared article, which we published a year ago, we showed that the United States patent of Edison which corresponds to the British patent on which the decision was based, expired and became public property on November 17th, 1884, under the operation of the statute of limitation, and the decision, therefore, merely emphasises the fact that certain inventions claimed in the patent are public property in the United States so far as Edison is concerned. In respect to the invention covered by the Sawyer and Man patent the case is quite different. The foreign decision establishes the novelty of the invention, that is to say, that it was not known in Great Britain and had not been described in printed publications prior to the date of the patent. In the United States, however, some time subsequent to the issue of the Sawyer and Man patent, a conflicting application for a patent for the same invention was made by Edward Weston. An interference was declared and stubbornly contested in the Patent Office at every step, the final result of which was a judgment of priority in favour of Weston, and the issue of a patent to him on October 21st, 1884 (No. 306,980), covering the same invention which by the English decision was adjudged to have been first made by Sawyer and Man. Hence, so far as the decision in this case has any effect in this country, it tends to establish the validity of the Weston patent for the treatment of carbons by the hydrocarbon process. It cannot have any effect upon the status of the United States patent of Sawyer and Man, as that has already been passed upon in the Patent Office. When either of these patents comes before the courts in this country, inquiry will necessarily be directed anew to the question of priority as between Weston and Sawyer and Man, although the question of novelty will, of course, again have to be passed upon, if called in question by the defence. The United States patent of Sawyer and Man is owned by the Consolidated Electric Light Company, and we understand that a suit is now pending against the Edison Company and others for its infringement. A suit has also been brought by the same company against the Edison Company on the fibrous carbon filament patent of Sawyer and Man, which will involve much the same issues as the suit on the British Edison patent."

Electric Lighting of H.M.S. "Mersey."—The official inspection of the electric light installation which has been fitted up by Messrs. Goolden & Trotter on board the armed cruiser *Mersey* at Chatham Dockyard took place on Tuesday last, the trial lasting from 4 p.m. till 11. Everything worked satisfactorily, and the usual certificate was granted to the contractors. The ship is expected to be ready for service by September, and is to be followed by three others in course of construction on the same lines.

Colonial Telegraphs.—On Friday last week, in the Conference Room of the Colonial and Indian Exhibition, a conference was held on the subject of "Colonial Telegraphs," Mr. G. H. Hawtayne, of British Guiana, in the chair. A paper was read by Mr. Sivewright, in which he said that the growth of telegraphs in the colonies was a true index to the growth of the colonies themselves. Australia could now boast of 33,863 miles of telegraphs, or 7,000 miles more than the mother country possessed. In South Africa the colonies had subscribed to a common convention and sent messages over 2,000 miles of wire at the charge of one shilling. He would suggest that there should be an Imperial federation of telegraphs, to precede the political federation of the Empire. The value of the telegraph to the outlying settlers of our colonies could not be exaggerated. In 1877 and 1878, in the last Caffre war, false reports of British defeats had been spread about in order to rouse the friendly tribes to revolt; but, owing to the news conveyed by the telegraph, these manœuvres proved unsuccessful. He would add that scant justice had been done to Mr. Crampton, who, when a company had been started for laying an electric cable across the Channel, to which the public subscribed only £300, and which several scientific men had pronounced certain to fail, put his own capital into the venture, and in the seven weeks which remained before the concession granted to the company expired caused a cable to be manufactured which was still a type of excellence. Mr. Crampton said that in his early days the public did not repose much confidence in him; but he was convinced that the work could be done, although if they had listened to all the difficulties that were raised its completion might have been delayed for 20 years. Afterwards, when the success of the enterprise had been demonstrated, the public, who had subscribed only £300, rushed in and wasted £100,000 in making too many cables. The chairman said that he came from a colony where there were 280 miles of telegraphs laid across deep and wide rivers and where sixpenny telegrams were first introduced. At present their communication with England was through the United States;

but they hoped to have this soon altered. Mr. Lant Carpenter mentioned that in New Zealand there existed a system of delayed messages at a cheaper rate, these messages being despatched after the other business for the day was over. A vote of thanks to Mr. Sivewright for his paper brought the meeting to a close.

The Western Union Telegraph Company. — The Western Union has been mulcted in damages amounting to $240,000 in the action brought against it by the Bankers' and Merchants' Telegraph Company, whose wires and other property the Western Union seized by force some months ago. This, says the *Financial News*, is a knock-down blow for the Western Union, and will certainly not tend to an early resumption of dividend payments. What with the existing rate war, which is playing havoc with its earnings, and costly litigations which involve it in further loss, the Western Union has come upon bad times, and it is not surprising that Mr. Gould is struggling hard to unload his holding, and to make an English market for the dividendless shares while the interest on the bonds, at least, is yet safe.

The Telegraph Cables of the World.—Dealing with Sir James Anderson's proposal, enunciated at the conference of the Chamber of Commerce at the Indian and Colonial Exhibition last week, for the nationalisation of the telegraph cables, the *Financial News* says :—"Sir James, being an adept in cable finance, had no difficulty in demonstrating that it would be a capital investment for the Governments if they only took it up in the right way. The capital invested in existing cables he estimated at £35,000,000, and the total revenue at £3,250,000. Expenditure and maintenance, at 35 per cent. of receipts, would be £1,137,000, bearing a net revenue of £2,112,000. From this the Governments might set aside £700,000 for renewals and reserve, and they would have enough over to pay 4 per cent. on the £35,000,000 of capital. Sir James hails, we believe, from the north, and there is a northern serenity about his proposal which becomes its parentage. If the Governments would only adopt it a good many awkward difficulties would be pleasantly solved. There would be an end to cable wars on the Atlantic, and we fear also to sixpenny rates. There would be no further need for cable pools, and stocks which at present are causing some anxiety to their owners, would be transformed into State annuities. Why should not this great and good work be done when, as Sir James Anderson shows, it would be so easy and remunerative? There are conceivable objections, though Sir James may consider them all trifling or irrelevant. At present public opinion is not in favour of private owners being relieved of their responsibilities, as witness the fate of Mr. Gladstone's Irish land scheme. If any Government wished to embark in the cable business, it would be hardly likely to buy old cables for four or five times the price at which it could get new ones. Sir James Anderson would not only expect it to do that, but he assumes that the companies would all be paid for their cables at their own valuation, regardless of old age, watered stock, and other financial casualties. The Anglo-American would include in its little bill cables lying broken at the bottom of the Atlantic, and never likely to carry another message. It would say nothing about certain bogus stock turned out years ago with a printing machine, and ever since treated as paid-up capital. Mr. Jay Gould would, perhaps, resent as impertinent any inquiry into the actual cost of the two cables which he has capitalised at nearly £1,500,000 sterling. Nor would the French company be very eager to explain how their shares happen to be standing in the market at 60 or 70 per cent. discount. To any Government meditating a deal with the cable pool we would say, 'consider what the public have made of it, and be warned.'"

French Atlantic Cable.—We notice in our contemporary, *Le Matin*, some severe strictures on the Compagnie Francaise du Télégraphe Paris à New York. The article calls attention to the mismanagement of the company by the group of financiers at the head of its affairs, and expresses the hope that the shareholders being now awakened as to the serious condition of their property, will take steps to prevent its sharing the fate of other companies which have come to grief while under the management of the very gentlemen who founded the Compagnie Francaise du Télégraphe Paris à New York. The following list gives the names of these gentlemen and of the companies which have failed while under their management: M. Pouyer-Quertier, Compagnie du Chemin de fer Orléans-Châlons; M. Ch. Le Cesne, Compagnie des Tramways Nord de Paris; M. Durangel, Société Financière de Paris; M. Clément Simon, Grande Compagnie d'Assurances; M. L. Riant and M. le Comte de Circourt, Union Générale.

Death by Lightning.—The *Gazzetta di Borgamo* relates that a few days since whilst a furious hurricane was raging a certain Luigi Maddalena, 68 years of age, superintending a house in reconstruction in the village of S. Caterina, along with a labourer named Mastori, was looking out at a window when the lightning burst on them with a tremendous crash. Maddalena had not time to utter a cry, dying at once; the other fell half stunned. The lightning first penetrated the roof, then going out on the front it entered by the window, struck Maddalena on the left shoulder, ranging along the body, always on the left side, and then having produced some excoriations and burned the skin over the stomach, it descended by the leg, splitting the shoe, and, making a very minute hole in the flooring of the chamber, ran into the lower floor, throwing to the ground a lad who was under the arch of the front door, and then discharged itself into the open air. Dr. Pagnoni, called in at once, perceived that Maddalena was dead. When Mastori had been carried to bed there was found no burn or mark whatever on his body. He said that he had experienced a very strong shock and a sense of excessive heat, and he felt a great prostration of energy. The boy had suffered a slight contusion on the shoulder, due to the fall.

The Edison and Swan Company and Users of Incandescent Lamps.—Messrs. Muir and Mavor, of Glasgow, have sent us for publication the following copy of a letter written by them to the Edison and Swan United Electric Lighting Company :—"*9th July*, 1886.—We have had sent to us by Isaac Holden, Esq., M.P., in whose residence we fitted a number of your lamps, a letter from you under date 1st July, 1886, as follows :—'We find that you are using electric incandescent lamps which are made in infringement of this company's patents, which have been recently upheld by the decree of the High Court of Justice, under proceedings instituted by the company against other infringers. I have to request that you will at once discontinue the use of these lamps, and upon your notifying me of your willingness to do this, I will make arrangements for sending for the lamps at such early date as may be convenient to you. If I hear from you not later than Thursday next, 8th inst., with the undertaking above-referred to, the company will abstain from taking proceedings against you, either for an injunction or for damages, a course which the directors have authorised me to take, in the belief that you were not aware that by the use of the lamps in question you were infringing the company's rights.' We think this a most unwarrantable and vexatious proceeding on your part, calculated to have a very prejudicial effect on your interests and ours. We are using your lamps exclusively, and think that you owe us an apology for this procedure.—Yours faithfully, *pro* MUIR and MAVOR, C. M."

The Electric Railway in Philadelphia.—The *Electrical World* states that owing to the success attending the electric railway on Ridge Avenue, Philadelphia, its track is to be extended 2,000 feet to Laurel Hill Cemetery gates.

Marriage of Miss Spagnoletti.—At St. Marylebone Church, on Wednesday, June 30th, Charlotte, eldest daughter of Mr. C. E. Spagnoletti, M.I.C.E., Past President of the Society of Telegraph-Engineers and Electricians, was married to Dr. Clabburn, of Burlington Cottage, Chiswick.

The Blackpool Electric Tramway. — Thus Mr. Holroyd Smith to a Blackpool paper: "But for the paragraph in your last issue (a copy of which has been forwarded to me) I should not have known what was 'whispered,' and shall feel obliged if you will give me an opportunity of contradicting it. My duties and connection with the Blackpool Electric Tramway Company have not ceased, as I still hold the position of consulting engineer, but am thankful to say that my professional services are seldom required, for the problems I had to solve have been reduced to such simplicity, that others, previously acquainted with mechanical science, can now undertake the arrangement."

Uruguay.—An amended patent law, bearing date 13th November, 1885, has been enacted by this rising South American State. Patents are granted for 3, 6 or 9 years, at the request of the applicant. They are subject to an annual tax of $25, for the payment of which 10 days' grace is allowed. A foreign patentee or his attorney or assignee may obtain a patent in Uruguay on application during the first year of his original patent. The invention must be worked in Uruguay within a reasonable term to be fixed by the authorities; this term may be extended under special circumstances on petition presented at least three months before its expiration. The working must further not be interrupted for the space of one year except good cause be shown for the patentee's inaction. Certificates of addition for improvements upon an invention are granted both to the original patentee and to others, subject to the payment of a tax equal in the one case to one-third and in the other case to two-thirds of the tax on the original patent. When the certificate of addition is obtained by a person other than the original patentee, the latter shall be entitled to a share in the royalties, to be settled by arbitration, or shall have the right to use the improvement covered by the certificate of addition. If there are two or more contemporaneous applicants for a patent for the same invention, the patent will be granted to neither until they come to an agreement. Infringement is punishable by fine or imprisonment, confiscation of the infringing goods, and indemnification to the patentee for the loss he has suffered; and those who aid and abet the infringement are liable equally with the infringer himself.

Monument to "The Inventor of the Telephone."—An Italian paper says:—"At Aosta on the morning of July 5th, the monument in honour and memory of Innocenzo Manzetti, the inventor of the telephone, was solemnly inaugurated under the portico of the municipal palace. There were present the widow of Manzetti and all his relatives. The captain of the fire brigade uncovered the monument to the strains of the royal march. The monument is of bronze, representing a shield raised at the corners and supported by two boys. At the base are seen the symbols of mechanics. On the monument is the inscription: 'To Innocenzo Manzetti, who devised and executed the first telephonic apparatus in the year 1864. The Association of Mechanical Industry and kindred Arts of Turin.'"

A Chronograph with a Magnetic Escapement.—At the session of the French Academy of Sciences, July 5th, M. Corneloup addressed a claim of priority with reference to the chronograph with a magnetic escapement presented by M. d'Arsonval on June 7th last, and which we described in the REVIEW for July 2nd. M. Corneloup's claim was submitted to MM. Mascart and Deprez for examination.

The Application of Electricity to War Purposes.—In the July number of the *Journal* of the Franklin Insitute appears the first instalment of a lecture delivered before the Franklin Institute by Capt. O. E. Michaelis, U.S.A., upon "The Applications of Electricity to the Development of Marksmanship.

The Promenade Concerts.—We hear that the series of Promenade Concerts, which Mr. Freeman Thomas intends resuming this summer at Covent Garden, will commence next month and that the theatre will be electrically lighted. We believe, however, that it has not yet been decided which electric lighting firm will fit up the installation.

The Royal Society of Edinburgh.—At the last meeting of the Royal Society of Edinburgh, Professor Tait read a paper by Professor C. G. Knott on the "Electric Resistance of Nickel at High Temperatures," in which it was stated that the electric resistance of nickel changed in a marked manner at the same temperature. This fact, Professor Knott held, seemed to show that all magnetic metals underwent changes of a very remarkable kind in their constitution at certain definite temperatures.

Electricity and the Falls of Clyde.—A scheme is, we understand, on foot for the utilisation of the Falls of Clyde for the production of electricity. The proposal is to construct several turbines at Stonehouse—the furthest down the river of the three falls—for the driving of dynamos for the generation of electricity, which would be conveyed by cables to the town of Lanark, in which light and power would be supplied.

The School of Submarine Telegraphy.—We notice that the recently illustrated prospectus of this school has been translated and published in our Italian contemporary, *L'Elettricista*. The fact of this having been done voluntarily is a good indication of the high opinion in which the school is held.

A Large Artificial Submarine Cable.—The School of Electrical Engineering, Hanover Square, possesses, we believe, the largest artificial cable for experimental purposes in existence. It consists of 34 boxes, each giving a capacity of 20 microfarads, or 680 microfarads in all.

Experiments in Electric Lighting.—In resolving to experiment with the electric light, says the *Gas World*, the Corporation of Hanley has exercised caution in spending public moneys. This caution is not always exhibited. Sometimes it happens that these conservators of the public interests and funds show that they are penny wise and pound foolish. At Hanley the Corporation resolved to spend the munificent sum of £20 in experimenting with the electric light. The experiment has been made, and Mr. Bradford, referring to it, told his brethren, at a meeting of the Council on Monday, that he did not think the lights could be made better than they were. Concluding his speech, he said: "If the place could be lighted with the electric light at the same cost they were put to for gas, all he could say was that it was a very beautiful and excellent agent."

Taking Advantage of Good Nature.—A rather peculiar proposal was submitted to the Maidstone Town Council recently. According to the *Gas World*, the Gas Company, during the electric light scare, lent itself to a Crystal Palace exhibition on a small scale by agreeing to supply gas to a certain number of large street lamps at a very low rate. Since then other large lamps have been erected in the town, but the Gas Company has not thought fit to supply these at an unremunerative rate. The proposal made to the Council was that the Gas Company should be asked to supply the gas to all the large lamps at the same low rate. Some astonishment was expressed at the idea, and the author of it agreed to defer his plan till the next meeting of the Council.

Incandescent Lamp Litigation in America.—Mr. Edward H. Johnson, president of the American Edison Electric Light Company, thus delivers himself with reference to the intentions of his company with respect to litigation, pending on the subject of incandescent lamps:—"The Edison Electric Light Company, having instituted suits on its patents, must decline to substitute the columns of the Press for the Courts for the purposes of their legal interpretation. Mr. Edison's carbon filament patent of 1879 covers broadly the modern incandescent lamp. The claim that this patent has ever been in litigation in the United States Patent Office is absolutely false. In Germany and England this fundamental patent has finally prevailed against all infringers, thus establishing the fact that Mr. Edison's great invention has been nowhere anticipated—*ergo*, a like result must follow in the United States. The straining and distorting of these facts together with the violent effort to interweave with them certain minor and irrelevant cases for the purpose of fraudulently posing before the public as joint heirs with Mr. Edison in the fruits of these patent decisions, only indicate the dire extremity of those who are thus gradually becoming environed by due process of law."

Temporary Lighting.—The Gülcher Electric Light and Power Company, Limited, is lighting the new building, belonging to Messrs. Allen & Sons, builders, for the Temperance Mission now being held at Kilburn. The installation consists of 40 20-C.P. incandescent lamps for the illumination of the large room where meetings are held nightly, with the addition of three arc lamps of 2,000 C.P. employed for the illumination of the Palmerston Road and the entrance to the building. The current for driving the installation is generated by a No. 4 Gülcher dynamo machine, and the motive power is obtained from Messrs. Allen and Sons' saw-mill engine. The Gülcher Electric Light and Power Company had only two days' notice to carry out this installation.

Crystal Palace Lighting.—The Gülcher Electric Light and Power Company, Limited, has erected an installation for the illumination of the grounds of the Crystal Palace which gives great satisfaction. The installation consists of 18 arc lamps, 17 of 2,000 C.P., and 1 of 3,000 C.P. The general effect is extremely pleasing, and will not fail to attract many visitors to the Palace. The lamps are supplied with current from two No. 4 Gülcher dynamo machines, which are driven by two of Messrs. Ransome's portable engines.

Telephonic Switchboards.—In referring last week to the switchboards being fitted in the exchanges of the United Telephone Company, we should have mentioned that they were the patent multiple switchboards of the Western Electric Company. We may reprint here the remarks of the chairman of the company at the meeting of shareholders on this subject: "We have just completed the renewal of two of our largest exchanges and our central trunk exchange with the most perfect switchboard in existence."

The Lalande-Chaperon Battery.—Under the heading of "A New Electric Light," the *Financial Chronicle* makes some remarks respecting the Lalande-Chaperon primary battery, stating that Mr. Stanley Currie, the engineer of the Standard Electric Light and Power Company, which company is exploiting the battery, believes that a steady electric light can be supplied by its means as cheaply as gas. We regret to say that we have not the faith in the battery which Mr. Stanley Currie evidently possesses.

Electric Light to the Rescue.—*Industries*, the new engineering journal published at Manchester, has a department devoted to "Foreign Industries." Therein we read that at the Exhibition of Lighting Apparatus at Brussels, organised by the Belgian Society of Engineers and Manufacturers, and which was closed on Tuesday last, the most interesting exhibit was that of M. Leon Lenaerts, in which electricity gives gas a helping hand. It is intended for large buildings, such as theatres, and permits of the gas being shut off at the main, either by the pressure of the hand or automatically, if the temperature increases beyond a certain point. The electric current is sent through a wire, fusing it and allowing the lever connected with the stop-cock to fall. This action mechanically moves a switch, sending the current through a circuit of incandescent lamps, showing the nearest way out, so that the audience is not left in darkness on the gas supply being turned off. By another arrangement, when the gas is turned off at the meter, any burner left on gives warning by keeping an electric bell ringing until the matter is set right.

The Electric Light on Ferry Boats.—The new ferry boats, for the supply of which the Birkenhead Town Council is contracting, are to be lighted by electricity or gas. The extreme length of the boats is not to exceed 150 feet, and the breadth must be 4 feet.

The Short Dynamo.—Denver papers give a description of the new dynamo exhibited there by Prof. Short, running lamps of 150, 16 and 10 C.P. up to a capacity of 100 16-C.P. lamps: "Prof. Short says that this is the smallest dynamo in the world for that capacity, and is less than half the weight of the best machine for the same number of lights. Its full capacity of 100 16-C.P. lights only requires 7½ H.P. In detail, the machine is but 14 by 12 inches, and 15 inches high. There are four field pieces, each 5 by 7 inches in size, and holding ten pounds of copper wire. The armature is 12 inches in diameter, carrying eight pounds No. 12 copper wire. The armature is triangular shaped, with wings fastened on the axle, which send a current of air continually through the armature and out at its edge, thus preventing any heat from possible friction. The field pieces are upright to allow getting at the magnetic field when wanted. The normal speed is 2,000 revolutions per minute. This little dynamo weighs but 400 pounds, yet is doing the same work that the 2,000 pound dynamos of Prof. Short's former construction are doing."

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Ryng Telephone Company, Limited.—The statutory return of this company, made up to the 2nd inst., was filed on the 9th inst. The nominal capital is £5,000 in £10 shares. 207 shares have been taken up and £8 per share has been called thereupon; the calls paid amounting to £1,635 10s., leaving £20 10s. unpaid. Registered office: St. Nicholas Chambers, Amen Corner, Newcastle-on-Tyne.

West African Telegraph Company, Limited.—An extraordinary general meeting of the members of this company was held at 98, Cannon Street, on the 11th ult., when resolutions were passed authorising alterations in the articles of association. One of these provides that sections 7 and 8 of the Companies Act, 1879, shall apply to the company as if it were a banking company within the meaning of the Act, and the provision therein contained relating to the audit of accounts, and the signature of balance sheets shall be treated as part of the articles of the company. Provided nevertheless, that Messrs. Kemp, Ford and Company shall be the auditors to examine the accounts of the company for the year ending 31st December, 1886, as if they had been appointed by the company in general meeting under the said Act, and their remuneration shall be 50 guineas as if it had been fixed by such meeting. The special resolutions were confirmed on the 2nd inst., and were duly registered on the 6th inst.

New Electro-Amalgamator Company, Limited.—An agreement, dated 7th inst. and registered on the same day, provides for the allotment of 442 fully paid shares

to certain creditors of the old company in satisfaction of their respective claims.

Mechanical Telephone Company, Limited.—The Board of Trade (Railway Department), by letter of 5th inst., have signified their approval of the name of this company being changed to the "Empire Telephone Company, Limited," in accordance with the resolution passed at a meeting held at the company's offices on the 4th ult. and confirmed on the 25th ult. The first return of the company, made up to the 4th December, 1885, was filed on the 1st inst. The nominal capital is £100,000 in 20,000 shares of £5 each. 9,153 shares have been taken up. Upon 553 shares the sum of £2 10s. per share has been called up, and upon 200 shares £5 per share has been called, the calls paid amounting to £2,347 10s., leaving £35 unpaid. 8,400 shares are considered as fully paid.

Bull's Power Company, Limited (Gas, Steam and Electric Appliances Manufacturers).—An order of the Chancery Division of the High Court of Justice, dated 3rd inst. and filed on the 8th inst., directs the winding up of this company, and the payment of the costs of the petitioner out of the assets, such costs to be taxed by the taxing master.

Gülcher Electric Light and Power Company, Limited.—An extraordinary general meeting of this company was held on the 10th ult. at the Cannon Street Hotel, when a resolution was passed altering the articles of association by striking out the following words from article 60, viz., "Provided always that the borrowing powers of the company be limited to the uncalled capital of the company for the time being." The resolution was confirmed at a meeting held at the Battersea Foundry on the 24th ult., and was duly registered on the 8th inst.

CITY NOTES.

The Eastern Telegraph Company, Limited.

THE twenty-eighth half-yearly ordinary general meeting was held at Winchester House, 50, Old Broad Street, on Thursday, under the presidency of Mr. John Pender, when the following report was adopted by the shareholders:—

"The revenue for the period amounted to £341,405 8s. 10d., from which are deducted £92,244 15s. 10d. for the ordinary expenses, and £41,637 3s. 2d. for expenditure relating to repairs and renewals of cables, &c., during the half year. After providing £3,940 4s. 11d. for income tax, there remains a balance of £203,583 4s. 11d., to which is added £32,549 12s. 5d. brought from the preceding half year, making a total available balance of £236,132 17s. 4d.

"From this balance there has been paid—

	£	s.	d.
Interest on debentures and debenture stock ...	27,756	17	10
Dividend on preference shares	20,296	16	10
An interim dividend of 1¼ per cent. on the ordinary shares	47,500	0	0
	£95,553	14	8

leaving a balance of £140,579 2s. 8d., from which £70,000 has been carried to general reserve.

"The directors now recommend the declaration of a final dividend for the year ended March 31st, 1886, of 2s. 6d. per share and a bonus of 1s. per share, amounting to £66,500, both payable on the 15th inst., making, with the three previous payments on account, a total distribution of 12s. per share, or 6 per cent. for the year on the ordinary shares. The balance of £4,079 2s. 8d. shown at the foot of the revenue account is proposed to be carried forward to the next half year.

"The revenue includes £9,750 dividend for the half year upon the company's shares in the Eastern and South African Telegraph Company. Also £2,600 net receipts for the same period on the shares of the Black Sea Telegraph Company belonging to this company.

"The receipts of this half year compare with those of a period when the income was abnormally increased by the telegrams resulting from the military operations in the East, and they have also been adversely affected by the continued commercial depression. The reductions in the tariffs agreed to at the International Telegraph Conference in Berlin, in 1885, came into operation on the 1st inst., but it is as yet too early to form an estimate of the probable effect on the company's revenue.

"The several sections of the company's cables and the land lines in connection therewith are in good working order with the exception of the Direct Lisbon Cable, which is now under repair by the company's ss. *Electra*.

"Since the last general meeting the arrangements with Her Majesty's Government for establishing telegraphic communication with the British Possessions on the West Coast of Africa have been completed, and the work is now being carried out by the African Direct Telegraph Company.

"The subscription by this company of £75,000, being one-third of the share capital of the African Direct Telegraph Company, approved by the last meeting of shareholders, has been effected by the issue of a similar amount of 4 per cent. debenture stock of this company."

The Direct United States Cable Company, Limited.

THE report of the directors for the six months ending 30th June states that the revenue for the half year, after deducting outpayments, amounted to £28,445 0s. 9d., against £36,106 1s. 1d., (after similar deductions) for the corresponding period of 1885; being a difference of £7,661 0s. 4d., against the half year under review, owing to the reduction of the tariff rate, mentioned in the eighth paragraph of this report.

The working and other expenses for the same period, including income tax, but exclusive of cost of repairs of cable, amounted to £15,866 19s. 7d., leaving a balance of £12,578 1s. 2d. as the net profit of the half year, making, with £5,967 1s. 3d. brought forward from the previous half year, a total of £18,545 2s. 5d. For the corresponding half year of 1885 the working expenses and other payments amounted to £17,206 15s. 11d., thus showing a reduction of £1,339 16s. 4d. in favour of the present half year. Every possible economy has been exercised in the several departments of the company's business.

Three quarterly interim dividends of ¾ per cent. each, amounting to £27,319 10s. 0d. have been declared and paid during the financial year, and a final dividend of 2s. per share is now proposed, making, with the three interim dividends, 2¾ per cent. for the year, being a total distribution of £33,390 10s. 0d.

The appropriation of the above balance of £18,545 2s. 5d. on the revenue account is thus shown:—

	£	s.	d.
Interim dividend for quarter ending 31st March, 1886	9,106	10	0
Final dividend now proposed	6,071	0	0
Carried to Reserve Fund	316	13	2
Carried forward to next account	3,050	19	3
	£18,545	2	5

During the current year the Reserve Fund has been increased by the interest on the investments, profit on sale of security, and sums transferred from revenue account, and now amounts to £325,000, after payment of the cost of repairs.

A break occurred in the short section of cable on the 7th February last, and was repaired on the 18th of the same month.

On the 5th May last the tariff and that of the associated companies was reduced to sixpence per word to New York, and by arrangement with the Western Union Telegraph Company this reduction also applies to most of the principal places in the United States of America and Canada. For press news a special rate of threepence per word between London and New York has also been adopted. On the same date the tariff of the Mackay-Bennett cables was reduced to one shilling per word.

So far the reduction has resulted in more than doubling the volume of traffic, and the directors are not without hope that with a revival of trade it may be further increased. The alteration has not, however, developed a remunerative revenue. In the interests of the public and the proprietors, the directors desire to give the experiment such a continuous trial as will afford the commercial community the benefit of a permanent low rate, if it is likely within a reasonable time to yield a return commensurate with the capital employed, and the risks involved, in the establishment and maintenance of the system.

Stock Exchange.—The Stock Exchange has appointed Friday, the 16th inst., a special settling day in the shares of the West African Telegraph Company, and the further issue of 2,000 preference and 2,000 ordinary shares of the Globe Telegraph and Trust Company. These shares will also be quoted in the official list.

India Rubber, Gutta Percha, and Telegraph Works Company, Limited.—The directors recommend the payment of an interim dividend of 5 per cent., or 10s. per share, free of income tax. The company's share register will be closed from the 13th inst. to the 21st, inclusive.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending July 9th were £2,451, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The West Coast of America Telegraph Company, Limited. The gross earnings for the month ending June 30th, were £3,200.

The Brazilian Submarine Telegraph Company Limited. The receipts for the week ending July 9th were £3,136.

NEW PATENTS—1886.

8901. "Making incandescent electric lamps." A. BERNSTEIN. Dated July 7.

8918. "Double current telegraph instruments for translating or repeating purposes." J. EDWARDS. Dated July 8.

8994. "Automatic telegraphy; apparatus used therefor; ordinary telegraphy." W. L. WISE. (Communicated by J. Rae and J. C. Simpson.) Dated July 9.

8995. "Telegraphic alphabets." W. L. WISE. (Communicated by J. Rae and J. C. Simpson.) Dated July 9.

9013. "Electric batteries, for increasing the power thereof." R. RAUSCHKE. Dated July 10.

9016. "Measuring the efficiency of an electric current." Sir W. THOMSON. Dated July 10.

9042. "Electric incandescence lamps and making illuminating conductors therefor." W. R. LAKE. (Communicated by A. Zanni.) Dated July 10.

9053. "Krotophones." E. S. SPAULDING. Dated July 12. (*Complete.*)

9056. "Dynamo-electric machines." W. MAXWELL. Dated July 12.

9079. "Electric arc lamps." E. CANTELLI, L. MUSSO. Dated July 12.

9082. "Gas batteries; applying same to electric lighting, &c." A. R. UPWARD, C. W. PRIDHAM. Dated July 12.

9085. "Electric accumulators or secondary batteries." V. LASS, K. FRIEDERICH. Dated July 12.

9088. "Construction and arrangement of cells particularly applicable to gravity batteries." R. H. COURTENAY. Dated July 12.

9102. "Electric clocks." J. CASSEY, J. F. DIXON. Dated July 13.

9126. "Electric meter." S. C. C. CURRIE. Dated July 13.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1885.

9415. "Improvements in electric batteries." J. H. JOHNSON. (Communicated from abroad by L. A. W. Desruelles, of Paris.) Dated August 7. 8d. Two liquids are employed in the improved battery, one being an exciting liquid employed for dissolving the soluble electrode, the other a depolarising liquid whose function is to absorb the hydrogen set free during the electrolysis. The exciting liquid is composed of water sulphuric acid which has macerated for about seven or eight days with peroxide of manganese, bisulphate or sulphate of peroxide of mercury oil and glycerine in the proportion of, say, about one thousand parts by weight of water to three hundred of the prepared sulphuric acid (at about 66° sp. gr.) eight parts of the sulphate, one part of colza oil, for example, and two of glycerine. The depolarising liquid is composed of water with the addition of an alkaline bichromate, such as bichromate of soda or potash, in proportion varying from, say, about one hundred to one thousand parts by weight of the bichromate to one thousand parts of water, and an equal quantity of sulphuric acid at about 66° sp. gr. This sulphuric acid is soaked or macerated with peroxide of manganese for about one month before it is used. To this mixture is added about one quarter of its weight of nitric acid at about 40° sp. gr. The zinc employed as the soluble electrode is carefully covered before being introduced into the existing liquid, prepared as hereinbefore described with a fatty or greasy coating composed of, say, about one hundred parts by weight of tallow, twenty-five parts by weight of paraffin, and three hundred of mercury, ground or pounded together. The electrical resistance of this coating is not sufficient to interfere with the working of the battery, but it protects the metal from the corroding action of the acid when the circuit is open. The positive electrode of the battery is constituted by plates of carbon prepared by soaking in water containing sugar, after which the plates are dried and exposed to a smoky flame, so that the sugar melts and is converted into caramel or burned sugar.

1886.

723. "Improvements in the construction of electro field magnets for dynamo-electric machines and electro-motors, or other purposes." R. KENNEDY. Dated January 16. 8d. Consists in constructing the field magnets of a broad cylindrical outer enclosing ring or casing, preferably of soft or cast iron, and closed in at each of its ends by a disc or side cheek of similar material, on the outer sides of which may be formed or secured bracketed bush bearings for carrying the spindle and driving pulley of the armature, and the commutator and other fittings of the dynamo or motor; or all these may be carried on a separate frame outside the casing. The side cheeks or discs have each on their inside surfaces one, two, or more projecting, preferably inclined or curved, ribs or flanges, which might be in the form of a ring with radial flat faces to form the poles projecting out towards the disc armature. Round the outer circumference of this ring, beyond the poles, is wound a circular or cylindrical coil of wire, which fills up the space between this and the outer enclosing cylindrical casing on each side and ends. These ends, with their coils and projecting parts, form the north and south magnets and poles on each side respectively of this new arrangement of electro or field magnet, and they are so constructed that the projections or radial poles on the one disc or magnet is placed opposite the hollow parts or centre space between the poles of the other, that is, with two poles in each at right angles to each other; and the revolving armature of the machine is mounted on its carrying spindle, between and close up to these projecting parts or poles.

4069. "Improvements in telephonic apparatus." J. E. DANN and J. LAPP. Dated March 23. 1s. 1d. The main object in view is to provide an improved speaking telephone for use on long lines to which the instruments in general use are not applicable. The system includes transmitting, receiving, and anti-induction apparatus, and relates chiefly to the adjustment of the transmitter. The claims are 25 in number.

4937. "Improvements relating to the conversion of heat energy into electrical energy and to apparatus therefor." W. R. LAKE. (Communicated from abroad by W. E. Case, of America.) Dated April 8. 8d. The apparatus consists of a containing vessel, which is closed hermetically by a cover. A plate, preferably of carbon, rests upon the bottom of the vessel. Connected with this plate is a rod of conducting material, which is covered with India-rubber or other suitable insulating substance. This rod extends through the cover and communicates with a binding screw to which one of the circuit wires is attached. Upon said plate is placed a quantity of pulverised metallic tin, which tin being in contact with the plate makes electrical connection with it. Another plate of carbon is surrounded with an envelope of porous non-conducting material, such as baked porous clay or pottery. Connected to this plate is a rod of conducting material surrounded with insulating material above said plate. The rod passes through the cover, and to it is connected a binding screw to which the other circuit wire is connected. In the vessel and surrounding the plates therein is placed a solution of chromic chloride. The apparatus thus constructed, at a normal temperature gives substantially no electrical current, that is, if it yields any current at all, the same is very small and is probably unavoidably due to impurities in the tin or liquid. With chemically pure materials it should, however, yield no current at all. On applying heat to the containing vessel and so raising the temperature of the liquid, a current becomes manifest. The claims are 12 in number.

5125. "Improvements in, and connected with, electric railways or tramways." P. M. JUSTICE. (Communicated from abroad by S. H. Short and J. W. Nesmith, both of America.) Dated April 13. 8d. The invention includes a conductor composed of sections properly insulated and adapted to the contact of moving current gatherers, the sections being connected by automatically closing contact pieces on said ends, and closing the circuit by contact with each other. In combination with an insulating bar or like device carried by a car or other vehicle, adapted to separate the circuit closers at the ends of the sections, and thus open the circuit, and hold it open while passing, the said bar having contact surfaces in circuit with an electric receptive device on the car. It includes also, in connection with the devices enumerated above, an electric generator, a return wire, and as a further element the arrangement of the sections substantially in the same line.

5273. "Arrangement for mounting and driving dynamo-electric machines." H. P. HOLT. Dated April 15. 6d. Relates to the mounting and driving of dynamo-electric machines, in such manner as to provide for supporting and varying, or entirely relieving the driving strain, and for lubrication of the bearings.

5276. "Improvements in telephonic apparatus." E. BERLINER. Dated April 15. 6d. In combination with the granulated conducting material, the inventor employs a vibratory plate or diaphragm preferably of carbon and a small carbon block, which latter is plunged into the granulated material. He also employs a curved conical sound funnel of soft India rubber or other suitable material. The carbon plate is pierced with holes which are not large enough to allow the granulated material to pass out, but will permit of the passage of the sound waves which impinge against the plate. The granulated material is enclosed in a box of somewhat smaller diameter than the diaphragm, and the edge of this box is fitted with a ring of some soft material which cushions against the diaphragm, but is not attached thereto.

PROCEEDINGS OF SOCIETIES.

Physical Society, June 12th, 1886.

DR. J. H. GLADSTONE, Vice-President, in the chair.

Dr. Samuel Rideal and Mr. E. C. Wellington were elected members of the society.

"On a method of distinguishing rays of solar from those of terrestrial origin," by Prof. CORNU. It has been shown by M. Fizeau that owing to the rotation of the sun upon its axis, there is a displacement of the spectral lines produced by solar absorption

towards the red or towards the violet, according as to whether the light examined emanates from those parts of the sun which are receding from or approaching us. If, however, the lines are the result of absorption by the earth's atmosphere, no such displacement should occur. It has been the aim of the author to make this principle the basis of a simple and instantaneous method of determining the origin of any given line. The displacement is very minute, amounting to about $\frac{1}{150}$th of the distance between the D lines for rays in that part of the spectrum when the light is from the extremity of the solar equator, but it has been found quite sufficient. Observations have been made with a Rowland grating, the mean distance of the lines being ·00176 mm. An image of the sun is formed upon the slit of the spectroscope by a lens. By a slight oscillatory motion given to the lens by a lever from the hand, any part of the sun's image can be brought upon the slit. A heleostat sends the rays always in the same direction, and by a prism the image has its equator horizontal. To distinguish between a line of solar and one of terrestrial origin, the line is brought near the vertical wire of the eye piece or, better still, one of those inevitable grains of dust which are always seen on the horizontal wire. The lever connected to the lens is then oscillated so as to bring alternately the two ends of the solar equator tangentially upon the slit. If the ray is of terrestrial origin it remains absolutely fixed, if it is solar it oscillates with the lever.

"On a Hyperbolagraph," by Mr. H. H. CUNNYNGHAME. It is not an unfrequent want to be able to find a rectangle of greatest or least area contained between a curve and rectangular co-ordinate axes. In several problems connected with motion and pressure in steam engines this is useful, and even in political economy the graphic representation of monopoly curves depends on maxima and minima of this nature. For the solution of such problems it is often very useful to be able to describe rectangular hyperbolas, and the author has devised a machine to effect this. It depends on a mathematical property of the rectangular hyperbola which he believes to be new, and which is as follows. From a fixed point let any line be drawn to meet a fixed line, and from the point of meeting draw a line perpendicular to the fixed line and equal in length to the first line. The locus of the extremity of the second line is a rectangular hyperbola, or if from a fixed point, O, a line, O, P, be drawn to meet a fixed line in a point, P, and P, Q, be taken perpendicular to the fixed line so that O, P + O, Q, be constant, then again the locus of Q is a rectangular hyperbola. In the machine the latter construction is mechanically and continuously carried out. A pencil, whose point corresponds in position to the point, Q, slides along a rule which is carried across the paper always perpendicularly to the fixed line. A fine steel wire attached to the pencil passes once round a roller at P, and is then carried to and coiled round a similar one at O. The use of a steel wire is a special feature of the apparatus and has a great advantage over string, which, owing to the facility with which it stretches, cannot give good results. The finest wire should be used; it unrolls from the one roller as much as it laps over the other, and its use may be extended to nearly all curve drawing machines.

A voltaic cell with a solid electrolyte was exhibited by Mr. Shelford-Bidwell. Its construction is as follows: upon a plate of copper is spread a layer of quite dry precipitated sulphide of copper; if on this a clean plate of silver is placed and the cell joined up to a galvanometer, a slight deflection is observed due to the unavoidable presence of moisture. If, however, the silver plate be covered with a slight film of sulphide of silver, by pouring on it a solution of sulphur in bisulphide of carbon and evaporating the free sulphur by heat, and then placing with the prepared side down as before, a deflection is obtained far greater than, and in the opposite direction to, the former. The resistance of the cell was very great, but was enormously reduced by compression; the E.M.F. was about ·07 volt.

JUNE 26th., 1886.

Prof. W. E. AYRTON, F.R.S., Vice-President, in the chair.

Mr. E. M. Langley was elected a member of the society.

The following communications were read:—

"On certain sources of error in connection with experiments on torsional vibrations," by Mr. HERBERT TOMLINSON. During a long series of researches on the torsional elasticity and internal friction of metals, the author has come across the following sources of error in connection with torsional vibrations. In some of the earlier experiments a horizontal brass bar was suspended by a wire and oscillated, the times of oscillation being observed by the ordinary lamp, mirror, and scale. The moment of inertia was varied by sliding two brass cylinders, suspended from the bar by fine wires, backwards and forwards along it. It was then found that under certain conditions the bar executed a few vibrations of rapidly decreasing amplitude, came to rest, and then commenced to swing again, the amplitude increasing to a maximum, again decreasing, and so on. This effect was finally traced to an approach to synchronism between the time of oscillation of the bar and that of the small cylinders about their axes of suspension, the absorption of energy being due to these being set in vibration. The effect entirely disappeared upon clamping the cylinders rigidly to the bar. On another occasion, however, the old phenomenon reappeared, and, after much time spent in investigating it, was found to be due to a somewhat similar cause, a near approach to synchronism between the periods of torsional and pendulous vibrations. If the axis of the wire passed accurately through the centre of mass of the vibrator this would not occur; but this condition it is practically impossible to fulfil. Another source of error lies in the fact that in a wire recently suspended the torsional vibration period will always be found to be slightly greater than when it has been suspended for some time and frequently oscillated.

"On a mode of driving electric tuning-forks," by Prof. S. P. THOMPSON. It is invariably found that the frequency of an electrically maintained fork is continually changing. This great inconvenience the author believes to be due to the fact that the impulses are given to the prongs at a disadvantageous moment, namely, when they are at the extremities of their swings. It is desirable that the impulse should be given at the middle of the swing, and to effect this it is suggested that each fork should make and break the circuit of the magnet influencing the other one, and it was shown how the electrical connections could be made to effect this in a simple manner.

"A further note on the formula of the electro-magnet and of the dynamo," by Prof. S. P. THOMPSON. In a paper recently communicated by the author it was shown that an expression given by Fröhlich for the intensity of magnetisation in terms of the magnetising force was nearly identical with one derivable from a simple law enunciated by Lamont. In a recent paper Fröhlich has further developed this law, and in the present paper the author has extended Fröhlich's results, and has applied them to the various forms of dynamos.

CORRESPONDENCE.

Primary Batteries.

Referring to your editorial foot-note to my letter of last week, I beg to reply, so far as I am concerned, with pleasure. I regret that Mr. Upward has not found it convenient, after all, to publish Dr. Oliver Lodge's report, as I feel sure we should all have been very much interested therein. There appears to me to be very little in Mr. Upward's letter calling for reply or remark on my part.

The theory which I ventured to suggest as the true interpretation of what goes on in Mr. Upward's battery, in spite of his very positive contradiction, is fully borne out by Mr. Dierman, who, I observe, agrees with me in several other points. I beg to cordially endorse the invitation contained in your note to his letter. As Mr. Dierman rightly points out, where you have water with an electric current passing through it, as in a battery, you will have electrolysis of the water, accompanied by oxidation of the generating plate, and delivery of hydrogen gas at the collecting plate. And, as every electrician who has studied the subject knows, one of the great difficulties in working out any new form of battery lies in the fact that as you must always use water, no matter what other agent you employ, you will always have hydrogen gas delivered at the negative plate of the battery, and must therefore find some means of neutralising it.

Mr. Upward objects to my description of his apparatus as complicated. I beg here to point out that I applied the term to the whole apparatus, not to the chlorine generator in particular; nevertheless, if anyone thinks that my objections are hypercritical, by all means let him try it, and I feel sure that before he has gone very far, unless either he or his domestic or both, are gifted with a treble portion of skill, time, and patience, he will soon wish he had never seen the —— apparatus. Why, sir, the very completeness of the apparatus, and the precautions that are taken to ensure its going properly are so many signs of weakness, and, as I have before pointed out, so many possible sources of failure with regard to bichromate batteries; if Mr. Upward had read my former letter carefully he would have seen that the very points claimed for the Regent battery are:—

1. That its zincs do not require re-amalgamating.
2. That the solutions employed are not as corrosive as that employed by Mr. Upward in generating his chlorine gas, and,
3. That the process of emptying and filling has been rendered very simple.

Sidney F. Walker.

Cardiff, *July 13th*, 1886.

A Menace to Electric Lighting.

It was in your issue of January 3rd, 1880, that I first ventured to put before your readers the impressions I had gained in Mr. Edison's laboratory in 1879, as to his ultimate success in solving the problem of the subdivision of the electric light. I mention this at the outset, not only because I think that such things are pleasant to dwell upon during the present crisis in the history of the incandescent lamp, but because I hail with satisfaction the verdict recently given in the incandescent lamp patent case in Mr. Edison's favour. Of course Messrs. Woodhouse and Rawson intend to appeal against that decision, but in my opinion it is only "throwing good money after bad." The Edison company's case is so clear that I cannot possibly see how in the name of common sense and justice any other decision than that of Mr. Justice Butt can be arrived at. What was the incandescent lamp before Edison appeared on the scene? It was a miserable failure, and would have been, so long as inventors simply looked at the subject of incandescent lighting from the narrow standpoint from which they then regarded it. Edison looked at the incandescent lamp as a means to an end. He was working out a system of electric lighting upon the same lines as the system of supplying gas lights, and it was only by so doing that he realised what no one had ever done before him, viz., that the lamp should have a high resistance. Even in his platinum-iridium lamp, Edison tried all he possibly could to make the "burner" have a high resistance. It was this high resistance business which even Mr. Swan missed, for after he produced a lamp he could only work his lamps in series with an automatic cut-out to each lamp, an arrangement which will never be practicable.

Mr. Edison then, seeing that platinum would not suit, sought something having a higher resistance, and showed us how to produce a carbonised filament, showed us how to attach that carbonised filament to platinum wires, and in fact how to construct a really practicable incandescent lamp. Further, Mr. Edison not only produced the lamp, but he has produced the only reliable system so far of satisfactorily working incandescent lamps. He was the first to show us that the lamps ought to be worked in multiple, while Mr. Swan, as just stated, advocated the series method. Mr. Edison was the first also to show us how to build big dynamos, how to keep the E.M.F. constant under varying loads, how to make fittings, electroliers, and switches, how to make and insert safety fuzes in the respective circuits, how to lay electric mains in the streets, how to lead out branch mains from junction boxes, how to measure the current in an accurate way, and how to work and to supply incandescent lights just as gas lights are done at present. In a word, Mr. Edison has taught us all we know about incandescent lighting.

Well, then, because Mr. Edison has shown us all these things, because he has led the way, his company is charged by you with menacing electric lighting by asking those people who have (either knowingly or unknowingly) purchased incandescent lamps from infringers to be so kind as to return those lamps. The Edison Company are indeed obliging, for they offer to send down for the lamps, and thus relieve the purchaser of the trouble of sending them. Well, then, what will the said purchaser do without his lamps? If he wants to continue electric lighting I suppose he will buy some fresh lamps from the Edison Company, and he will pronounce his blessing upon the people who sold him the original lamps. But who is responsible for this state of things? Who has menaced electric lighting? Not the Edison Company, but the infringers. This is a matter which you, sirs, seem altogether to forget. Unfortunately there are persons in the world who, not having the brains to produce anything original themselves, will persist in reproducing other men's ideas. This is what the patent law is intended to prevent. When it fails to fulfil that mission we may say farewell to all that stimulates inventive talent.

But, further on in your leader, in which I think in giving vent to your feelings you have blamed the wrong parties all along, you say: "Another well-known corporation might follow suit and try in earnest to create a 'corner' in compound wound dynamos; then a third electrical company might pursue similar tactics with regard to secondary batteries." The remarks you make in regard to insulating copper conductors are really too absurd. But supposing that compound dynamos and storage batteries became private property, we could do very well without them. They are by no means essential to electric lighting, they are merely adjuncts. Edison does without them, and so can we. At any rate they will not be required in electric light supply systems in the future.

For myself I believe great good will come out of the recent action. There is a sifting time coming round both in this country and in America. Electric lighting engineers want sifting badly. When the riddling time comes round, no doubt I shall go through the sieve along with the majority. But there will be those whose minds are too big to allow them to drop through, who will remain on the other side of the screen. They will ask themselves whether, after all, 200 candles per horse-power and a lifetime of 1,000 hours is such a wonderful result. They will ask themselves whether they have completely unveiled all the hidden treasures which Nature can reveal; and if they look at the subject in that light I think their labours will soon be rewarded.

Charles Lever.

Erskine House, Colwyn Bay, N.W.,
July 13th, 1886.

[Mr. Lever has once more allowed his pen to run away with him. In his hero-worship he forgets several facts which most people would consider important in their bearing upon this discussion, and introduces other matter which is entirely irrelevant. For instance, how does the fact that Mr. Edison was the first to make big dynamos affect the question as to his right to a monopoly in the manufacture of incandescent lamps? But having asked that question, we would suggest that there is not much merit in making big dynamos which are so badly constructed electrically that, to make them serviceable, others have to take them in hand and eradicate their numerous defects. Mr. Lever thinks it unfortunate that there are persons in the world who "will persist in reproducing other men's ideas," not having the brains to produce anything original themselves. Are not the principal inventions of Mr. Edison, including even the incandescent lamp itself, merely reproductions of other men's ideas, conjoined certainly with important modifications? And why should others be prevented from acting upon the same principle? Mr. Lever's name is not entirely unknown at the Patent Office; we ask him, does he think his own inventions betray any striking degree of originality on his part? We do not for a moment suggest that they are not valuable, however. Mr. Lever says the incandescent lamp previous to Edison's researches was a miserable failure. It would be just as strong an argument in Graham Bell's favour to say that anterior to his patents practicable telephony was unknown. Yet Mr. Lever could write a few short months ago such passages as the following: "The fact is that the United Telephone Company cannot and will not attack Prof. Thompson's Valve telephone in the face of the scientific evidence which can be produced as to the non-infringement of the same. Already the telephone monopoly, both in this country and in the United States, is on its last legs. And when this structure of telephone monopoly at last goes reeling and toppling over we shall not be at all sorry, but we shall gladly hail the day that brings us free trade in telephones." And pray why not free trade in incandescent lamps? Scientific evidence of non-infringement is not wanting in the latter regard any more than in connection with telephones, and the questions of equity in the two cases are very similar. We fear, as we have had occasion to remark before, that

where Mr. Lever's enthusiasm has been aroused he rushes to conclusions (and "into print") without bestowing that mature consideration upon the subject which a calmer mind would deem at least advisable.—EDS. ELEC. REV.]

The Upward Primary Battery.

With reference to Mr. Dièrman's letter of last week, allow me to make the following criticisms.

The use of a lead plate instead of a carbon plate.

There are two objections to this:—1. It would cause reduction in E.M.F., since it would be a zinc lead instead of a zinc carbon cell.

2. In addition to the local action caused by the contact of lead and carbon in an aqueous solution of chlorine, there would be the formation of a film of lead chloride, which is practically insoluble salt, and would probably almost stop the action of the cell altogether.

Parchment paper used as a diaphragm. Of course there is no novelty in this, as it is a common way of making up a standard Daniell, and could not be made the subject of a valid patent. The practical disadvantages are only too obvious. How long would parchment paper last in the presence of hydrochloric acid and free chlorine? By using this system not only would there be emptying and filling with liquids (salt water added and chloride of zinc removed), but there would also be the additional aggravation of changing porous pots.

Important as is the matter of internal resistance in a battery used for domestic lighting, there is a point of still greater importance, viz., permanence and absence of attention, and if a battery possesses the peculiarity of continuous working, the three disadvantages of internal resistance, viz., wasteful working, heavy prime cost for a given number of lights, and variation of terminal E.M.F. with variation of external resistance, are entirely got over by the use of secondary batteries, which, of course, enable the primary battery to work at a lower rate for the 18 or 20 hours that no light is being used, and in parallel with them feed the external circuit during the five or six working hours.

In conclusion, the use of chloride of zinc and sodium chloride (common salt) would probably result in the formation of the double chloride, which is insoluble, and give rise to a similar, if not a worse, difficulty at the zinc plate to that which was pointed out above as occurring with a lead one.

With regard to the electro-chemical theory of the Upward battery, I can simply refer Mr. Dierman to my letter in the issue of July 9th, at the same time asking Mr. Dierman what chemical compound he intends to represent by HO.

I do not, of course, wish to criticise Mr. Dierman's battery before he describes it; the above remarks are merely objections to his letter which would, I think, occur to most people on reading it.

A. René Upward.

West Kensington, *July 14th.*

Professor Hughes on Self-Induction.

Your last number contains a critique by Prof. H. F. Weber upon my papers on "Self-Induction of an Electric Current in Relation to the Nature and Form of its Conductor."

The critique neglects almost the whole of the results which I have obtained, confining itself to a single portion, viz., the coefficient of self-induction of straight wires of non-magnetic metals.

In this there should be no real cause for divergence of views, as I have shown very similar results to that which he has obtained; but I object to portions of a sentence in my paper being quoted, thus apparently making me say exactly opposite to that which my experiments have shown.

Prof. Weber wishes to prove that I have said that there is a difference of specific inductive capacity in the non-magnetic metals independent of their specific resistance or geometrical form. This is certainly far from what my experiments have shown, and in order to render this portion of my first paper more clear, I said in my reply to the discussion and in answer to a question asked by Lord Rayleigh on this subject:

> I have shown a remarkable difference in the inductive capacity of different metals when formed into wires of the same diameter; and as the order follows that of their respective specific resistances, it became an interesting study to know what would be the result if all the wires were of the same length and resistance. It is necessary to employ the same length, as the induction increases with the length; consequently a copper wire, compared with a brass wire of equal resistance, and therefore of greater length, would show a great difference in their inductive capacities. There are, however, several methods, free from experimental errors, which I have employed in this investigation.
>
> If we take wires of different non-magnetic metals of the same length and diameter, and reduce them to the same resistance by an added resistance comparatively free from induction, such as carbon, I find that there is apparently no difference whatever in the inductive capacity of the different metals, all (yet tried) giving by this method very nearly the same result; but in this case we have added an external resistance, and thus prevented any difference of action due to the different density of the current in metals of high and low resistance.
>
> If, instead of an added external resistance, we take wires of the same length and resistance, but of different diameters, we then find a marked difference in their inductive capacities; for instance, a pure copper wire, compared with a brass wire of double the diameter, shows a marked higher force in the copper wire. We might naturally believe that the brass wire, from its larger diameter, would give higher results than the smaller copper wire; but if we have thoroughly seized the importance of the phenomenon which I have demonstrated of the reaction of contiguous portions of the current on each other, we can easily prove that the larger the diameter of the wire the less will be its proportionate reactions, so that, whilst the resistance decreases directly as the increase in section, the reactions of the currents upon each other become *less* as the diameter increases, the resistance diminishing as a straight line, whilst the induction would follow a curve similar to that shown in the diagram.

Prof. Weber quotes a few words from my first paper, which, from its brevity, might lead to an erroneous interpretation, but he has not taken notice of the above reply, in which I have endeavoured to render my meaning more clear. He also quotes a portion of a sentence in my last paper, thus: "I have shown, thirdly, that the inductive capacities of different metals depend on their resistance." The whole sentence reads thus:—

> If we regard the whole of these researches we cannot fail to notice certain important laws which act in the greater portion of them. I have shown:—1st. That the contiguous portions of the same current react upon each other in the interior of its own portion of the conductor similar to their known exterior reactions on separate portions of the same conductor. 2nd. That the coefficient of mutual induction is less in iron than copper wires, but that their coefficient is the same when the conductor is in the form of a ribbon. 3rd. That the inductive capacity of different metals depends on their specific resistance, on their electro-magnetic capacity for circular magnetism, and on the geometrical form of their conductors. 4th. That the inductive capacity of a conductor of magnetic metal is dependent upon the formation of circular magnetism and not upon its internal magnetic permeability. 5th. That a magnetic metal can be rendered equally free from circular magnetism as the non-magnetic metals. 6th. That we have experimental evidence of electro-magnetic inertia and the deleterious effects of eddy currents in the cores of electro-magnets.
>
> In addition to the above effects, we have the discovery of a large increase in the ohmic resistance during the variable period, allowing us to demonstrate and measure the gradual rise of an electric current in its conductor.

The methods which I have employed in these researches do not find favour with Professor Weber, although the results which I have announced are in perfect accord with known practical experience. We now know the reason why a copper conductor is superior for telegraphic and telephonic purposes, and we can now appreciate the labours of Sir W. Snow Harris and Prof. Guillemin on lightning conductors, as we know the cause of the effects remarked by them. Prof. Weber prefers a method of his own, which he regards as perfection. Let us hope that by its means he may be enabled to do some original research which shall be an advance on our present knowledge.

The researches which I have made cover such a vast field that it is quite possible some expressions from their brevity may not be as clear as desirable, but the experiments were most carefully made and verified, the results of which seem to me to be of some importance to most of our practical applications. It is only by a study of the whole of the results that we can arrive at a fair appreciation of their value, and as I have no taste for discussions, I must leave to Prof. Weber the duty of being the critic, whilst in future I hope to confine my attention to fresh researches upon the same subject.

D. E. Hughes.

London, *July 12th*, 1886.

English Telephone Patents.

With reference to your article on the above in your issue for to-day, allow me to point out that the Bassano instrument might well be considered to infringe the Edison patent, even though the base board were dispensed with, without in any way putting forward the obviously absurd and untenable contention that the air is a diaphragm.

The microphone in their instrument is mounted in a tube or mouthpiece made of thin wood, and it was clearly shown in Court that this mouthpiece took up to a considerable extent the atmospheric sound vibrations and communicated them mechanically to the microphone, these acting, as was contended, the part of Edison's diaphragm.

I do not say that this latter contention is valid; in my opinion it is not so; but this is undoubtedly the line of attack that the United Telephone Company would adopt were an instrument of the kind placed in the market.

There can be no doubt whatever that a baseless Bassano instrument does work almost entirely owing to the vibrations of the mouth-piece, and scarcely, if at all, by the direct impact of the air waves on the microphonic pencils, as the defendants tried to make out at the first trial of the case; and, further, it is certain that a Bassano microphone without base or mouthpiece, or other auxiliary sound-receiving surface, will not constitute a commercially efficient telephone transmitter.

I may mention that experiments lead me to believe that the Valve transmitter of the New Telephone Company works also through the vibrations of the mouthpiece and tube, both of which are of wood, and not, as we are given to understand, by the direct impact of the sound waves causing the ball valve to jump up and down.

"Telephonist."

July 2nd, 1886.

Bell's Telephone Patents in the United States.

I send you a synopsis of the report to the House of Representatives made by a committee of that House, appointed to investigate into the relations existing between high officers of the Government and the Pan Electric Telephone Company, an opponent of the Bell Company. That report entirely exonerates the Attorney-General and others from any dishonourable conduct; and as the outrageous charges made against that officer were industriously circulated in England, I hope you will give place for the following, taken from a Washington newspaper of this date.

COMPLETE VINDICATION.

The committee of the House which has made such an exhaustive investigation of the outrageous charges againt Attorney-General Garland, Secretary Lamar and others, yesterday handed up a majority report exonerating all parties concerned in the most explicit and comprehensive manner.

Here is the resolution signed by all the members of the committee except the offensive partisans:

Resolved—That a full, fair and exhaustive investigation has failed to adduce any evidence which tends to show that Attorney-General Garland, Solicitor-General Goode, Secretary Lamar, Indian Commissioner Atkins, Railroad Commissioner Johnston, or Senator Harris (they being the officers named in the Pan Electric publications of the newspaper press which gave rise to this investigation), did any act, officially or otherwise connected with the matters investigated, which was dishonest, dishonourable, or censurable.

C. E. BOYLE, JOHN R. EDEN,
WILLIAM C. OATES, BENTON J. HALL.
J. B. HALE,

Telephone patents are being granted every week, in face of the fact that the Bell patent *here* covers the use of the undulatory current, in a closed circuit, and all the patents issued use the *closed* circuit. A company has been formed in a small town in Virginia to work, or rather, to speculate in certain telephone patents granted to W. C. Turnbull—all of which are clearly infringements of Bell's, they using the *undulatory current*—but this *great* invention is heralded as one which will talk from New York to London; and the promoters of this new company are endeavouring to sell shares (*at any price*) to ignorant capitalists; but I hear that, as yet, no money has come into the coffers of the company, and very little has been paid out by the promoters for experiments, or otherwise.

In the REVIEW of June 11th, in your comments on my letter about Bell's late patent for "Recording and reproducing speech and other sounds," you say that "you do not see any similarity between that patent and the patent of Mr. A. F. St. George, as the patent of Bell refers to improvements in phonographs." It seems to me that you have not examined the St. George specifications, for he therein describes a method for recording speech transmitted by the usual telephonic instruments; also a method for using that record for transmitting the same speech; you will find that Bell's specification describes instruments for "Reading and reproducing speech and other sounds." Now it seems to me that to St. George belongs the right of being the first to invent and patent such an instrument—"*Palnam qui meruit ferat.*"

This, my native land, is a *great* country; we are now about to have the *largest* telescope in the world, as you will learn from the enclosed description of one now being constructed; a few years ago we put the cap stone on the *tallest* monument ever erected by man in the world; and I recollect when I was a mere lad, some sixty years ago, I was greatly impressed with the following, said by a representative of a *genuine* Yankee on the stage:—"This is the greatest country on yearth; we have the longest rivers, the highest mountains, the loudest thunder, the brightest lightning, and the d**n*st rascals in the world;" and I think we can now claim that we are the *first* inventors of every *great* and *useful machine*, and that we have produced more *first* inventors of the *same machine* than any other country has produced imitators. There is Bell who, in 1876, invented Bourseul's telephone, described in a newspaper in 1854; there is Edison, who lately invented a system of telegraphing from a moving train, which was patented in 1881. I might fill your REVIEW with the names of many such inventors, but I will not inflict such a punishment upon your intelligent readers.

W. C. Barney.

Washington, July 2nd, 1886.

All is not Gold that Glitters.

The narrative of your experience in recovering tin from scrap by electrical process shows what different results accrue where things are done by the ton instead of by pounds and ounces. It is one thing to send a few grains of bright tin by post, but it is another to work on the scale of 20 tons per week.

It is not a very novel proposal to recover tin by means of electricity, and almost every imaginable means of doing so has been patented. A full description of a method is given in the Transactions of the Society for the Promotion of Chemical Industry, by Dr. J. H. Smith, who uses a dynamo, and for a solvent sulphuric acid. A large quantity of tin scrap is treated annually at Bir-

mingham by means of hydro-chloric acid, and the tin is precipitated by zinc, but the iron seems to be spoilt by the acid and tin jointly, and is not of much value. It is said the Electro Metal Company proposes to use an acid solvent—then the iron must not reckon for much.

Electron.

The Work Performed in Telegraphing.

On page 204 of the late volume Mr. Moon makes use of the equation $\frac{E\,c\,t}{1{,}325}$ = foot pounds. Will someone kindly explain how the number 1,325 is obtained.

Ita. MR.

[Mr. Moon will doubtless satisfy our correspondent. —EDS. ELEC. REV.]

Electro-Motors.

It is rarely that one finds in the same issue of a technical journal opinions so diametrically opposite as those expressed in your review on Mr. Kapp's book and in the article "Electro-Motors," by "An Engineer." In the latter article the reversibility of the dynamo is insisted on, and it is stated that both motors and generators must be constructed on the same lines, whereas in the former it is affirmed with equal emphasis that motors and generators work on different principles; the field-magnets in the former being strengthened by the armature current, and in the latter weakened by it. Almost every statement on the part of "An Engineer" is negatived by the reviewer, and the student, between the two, is worse off than ever.

The reviewer says that considering the direction of rotation, in a motor the attracting poles of armature and magnets are the nearer pair, the repelling poles the farther pair, and that in the generator the opposite holds good. This is not the case if in the motor the brushes are set backwards, for then the poles have the same relative positions, and motors are, in practice, always worked with a backward displacement, if any displacement at all is required. Referring to the results of Mr. Mordey, it has been known for years that the speed of a motor depends on E — C R, where E is the electromotive force at the terminals, C the current, and R the resistance; and that if the field is constant and R practically 0, the speed is independent of the load. Mr. Mordey's experiments merely verify a fact known long before they were made. Personally, I should be glad if the subject were discussed by others who are more thoroughly conversant with it than

A Student.

Telephonic Translators.

In Mr. Lockwood's article, "Some Recent Advances in Telephony," published in your last issue, it is claimed that the first use of induction coils wound with two circuits of approximately equal resistance for the purpose of connecting metallic circuits to ordinary single lines was made in September, 1879, by Mr. Lockwood. It is also distinctly stated that the results obtained were beneficial, and that conversation was successfully carried on between Boston and Lowell by means of such coils about that date.

In a communication to your contemporary, the *Electrician*, of March 3rd, 1883, Mr. Lockwood likewise claimed the use of induction coils in 1879, but on that occasion he explicitly stated that no benefit was derived from their use. This admitted failure, and an allusion he made to the Blake transmitter led to the inference that he had employed in the experiment ordinary Blake transmitter induction coils.

Between these two statements there is a discrepancy which calls for explanation.

In 1881 I took out a patent for the use of translating coils wound with wires of approximately equal resistance, and obtained highly satisfactory results from them. Since that date they have come into extensive employment in this country and on the continent, and I believe I am strictly entitled to claim that telephonic inter-town communication has been very greatly furthered by their introduction. Although patented only in 1881, I really invented the system in 1880, if not in 1879. The idea was suggested by Professor Hughes's paper, "Means of Preventing Induction upon Lateral Wires," which was read on March 12th, 1879, and I am inclined to think that it occurred to me soon after that date, although I cannot, at this distance of time, be certain. At all events, I can prove by independent testimony that I was in possession of it in 1880. The patent was delayed, because at the time the invention was made there was no field for applying it in this country.

In 1881 the National Telephone Company brought over a number of American electricians who were engaged expressly because they were well posted in the very latest American telephonic practice. They were from all parts of the union, and some of them claimed acquaintance with Mr. Lockwood, yet none had ever heard of the use of induction coil translators before they became acquainted with my patent.

Subsequent to 1879 Mr. Lockwood published a book which professed to give the latest information about telephones, but such coils were not referred to in it.

Illustrated descriptions of my patent appeared in the ELECTRICAL REVIEW and the *Electrician* of January 13th, 1883.

As already pointed out, Mr. Lockwood in March, 1883, admits that failure had attended his experiments up to that date.

In 1886 he goes back on that admission and claims success from 1879. In face of this alleged success, it is at least singular that in such a country for patents as the United States no steps were taken to protect the arrangement.

In 1883 I received a letter from Mr. Haskins, secretary to the Wisconsin Telephone Company, Milwaukee, in which he said that attempts had been made in the States to use translating coils but without success, as the volume of sound was so greatly decreased. This would be an effect of using Blake transmitter coils.

Under these very peculiar circumstances I consider myself justified in declining to admit that Mr. Lockwood's failure in 1879 was identical with my success in 1881. If he used Blake transmitter coils, as seems probable, his failure is at once explained.

His description of the construction of the successful coils which you published last week is identically the same as that of my specification of 1881.

The facts appear to be that some experiments were really made in America, but with uniform want of success until after the publication of my patent.

Another fact which tells against the probability that Lockwood's 1879 apparatus was the same as mine is his statement, that during the Boston-Lowell experiments "Mr. Watson engineered the induction coil." Such coils as mine require neither engineering nor superintendence. The connections once made, the coils may be left to themselves. The Mr. Watson who performed this engineering feat is stated by Lockwood in the earlier part of his paper to have been long regarded as a supposititious character.

The invention is not one which possesses any particular merit from a scientific point of view, although it has had important results in practice. It is a device which was quite likely to occur simultaneously to two or more minds engaged on the advancement of telephony, and I would have been quite willing to admit Mr. Lockwood's claim in a generous spirit had it not been vitiated by the obscure and contradictory statements from his own pen.

A. R. Bennett.

90A, George Street, Edinburgh,
July 12th, 1886.